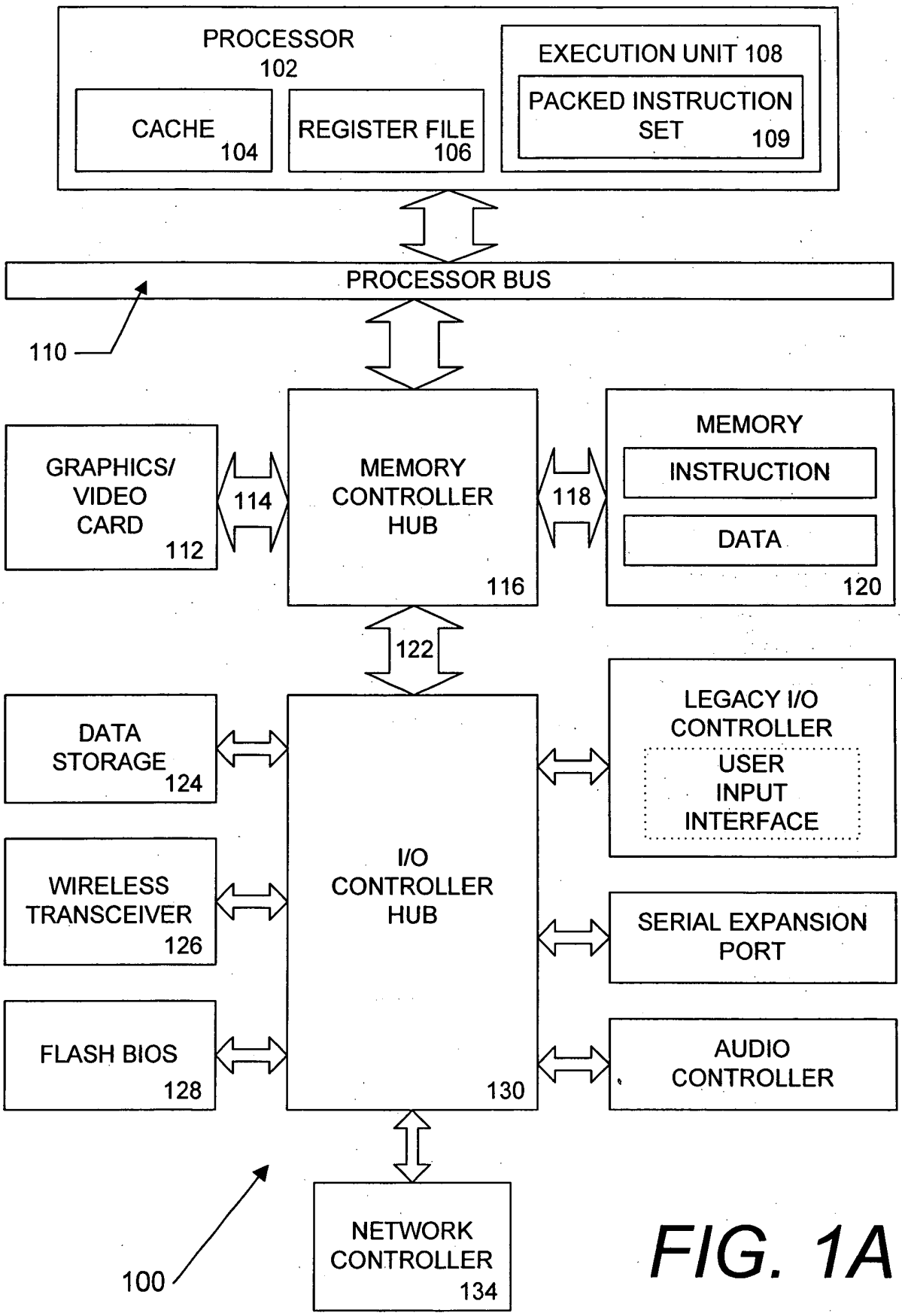

PROCESSOR
102
CACHE
104
REGISTER FILE
106
EXECUTION UNIT 108
PACKED INSTRUCTION SET
109
PROCESSOR BUS
110
GRAPHICS/
VIDEO
CARD
112
114
MEMORY
CONTROLLER
HUB
116
118
MEMORY
INSTRUCTION
DATA
120
122
DATA
STORAGE
124
WIRELESS
TRANSCEIVER
126
FLASH BIOS
128
I/O
CONTROLLER
HUB
130
LEGACY I/O
CONTROLLER
USER
INPUT
INTERFACE
SERIAL EXPANSION
PORT
AUDIO
CONTROLLER
NETWORK
CONTROLLER
134
100

FIG. 1A

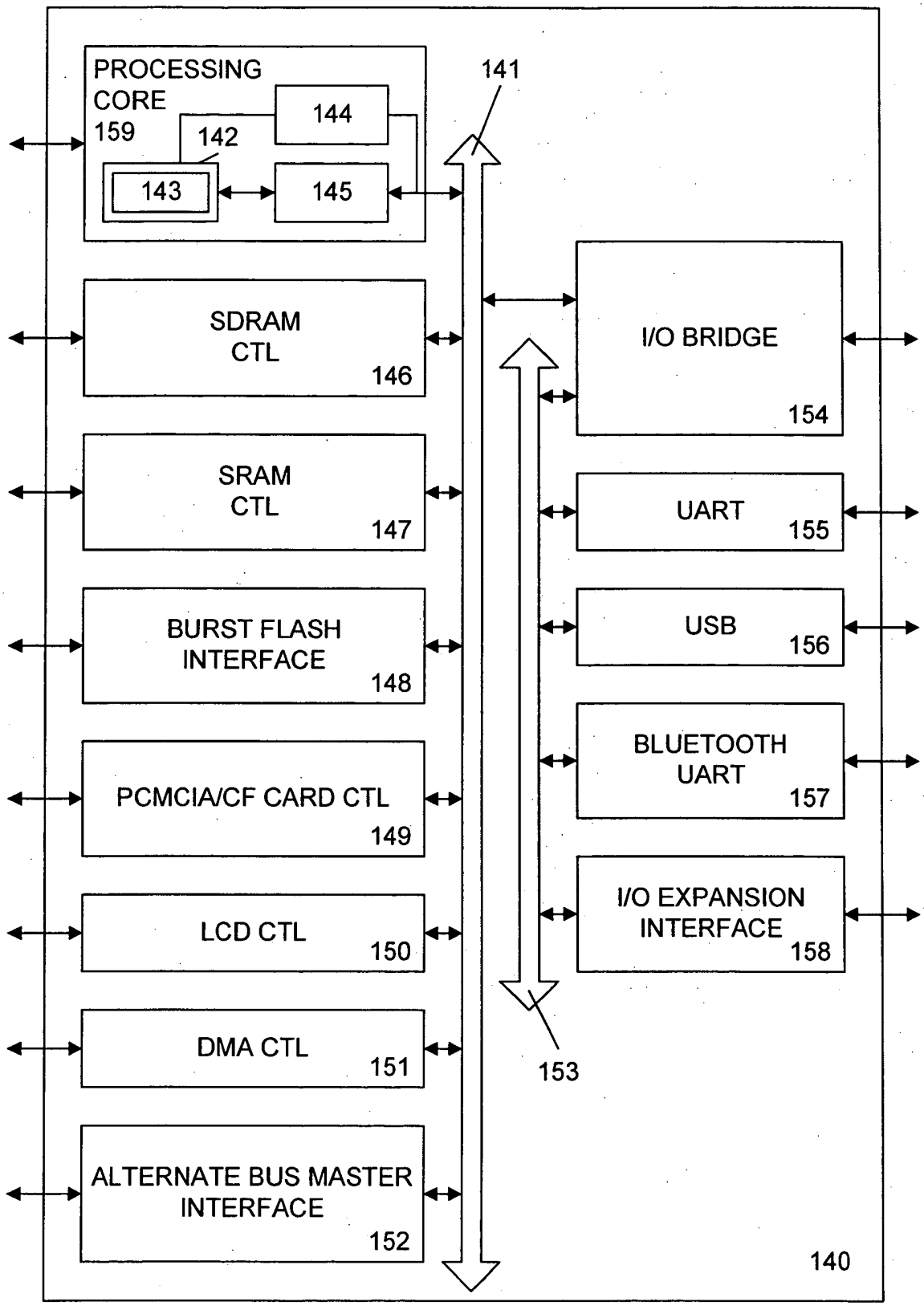

PROCESSING
CORE
159
144
142
143
145
141
SDRAM
CTL
146
SRAM
CTL
147
BURST FLASH
INTERFACE
148
PCMCIA/CF CARD CTL
149
LCD CTL
150
DMA CTL
151
ALTERNATE BUS MASTER
INTERFACE
152
I/O BRIDGE
154
UART
155
USB
156
BLUETOOTH
UART
157
I/O EXPANSION
INTERFACE
158
153
140

FIG. 1B

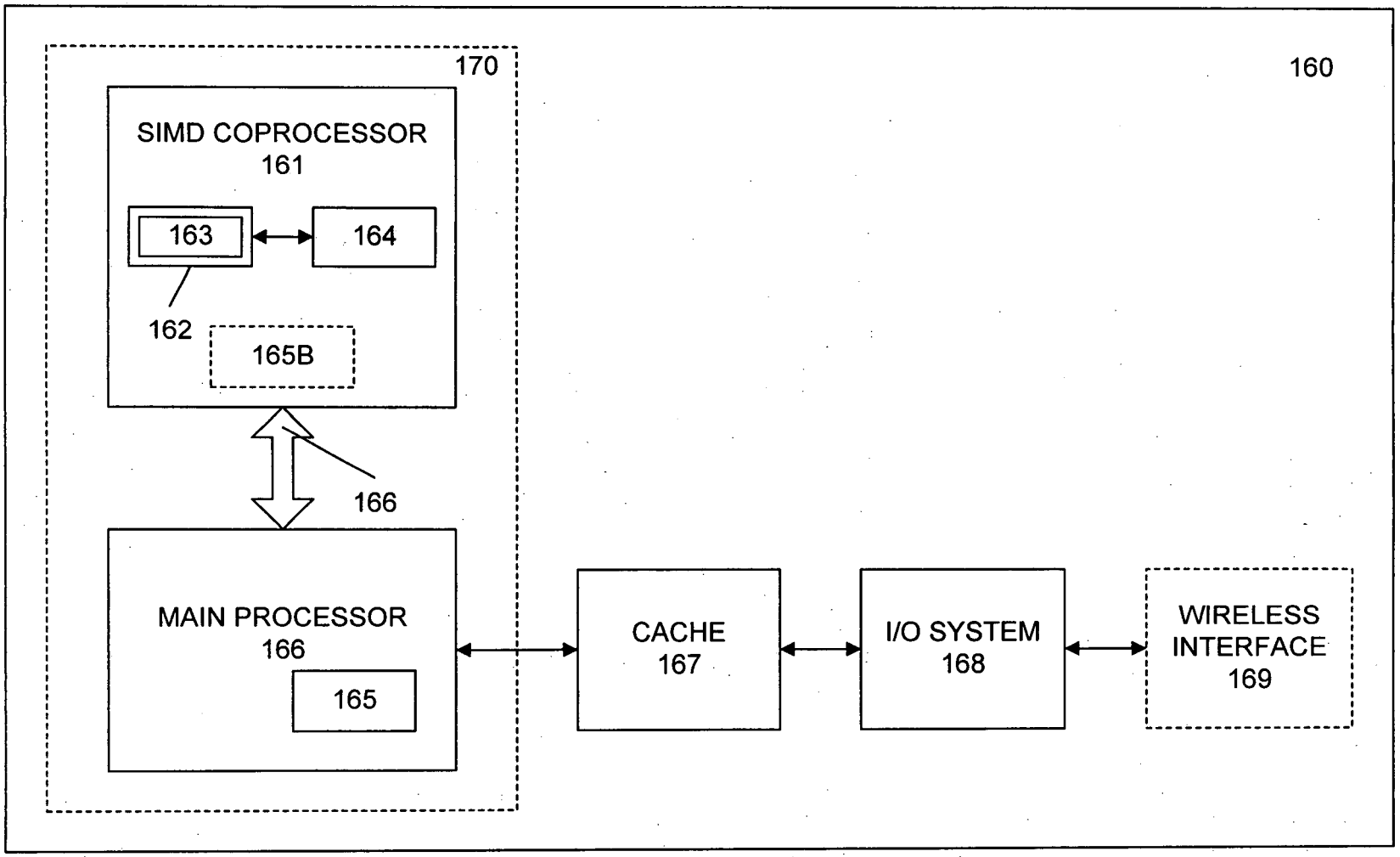
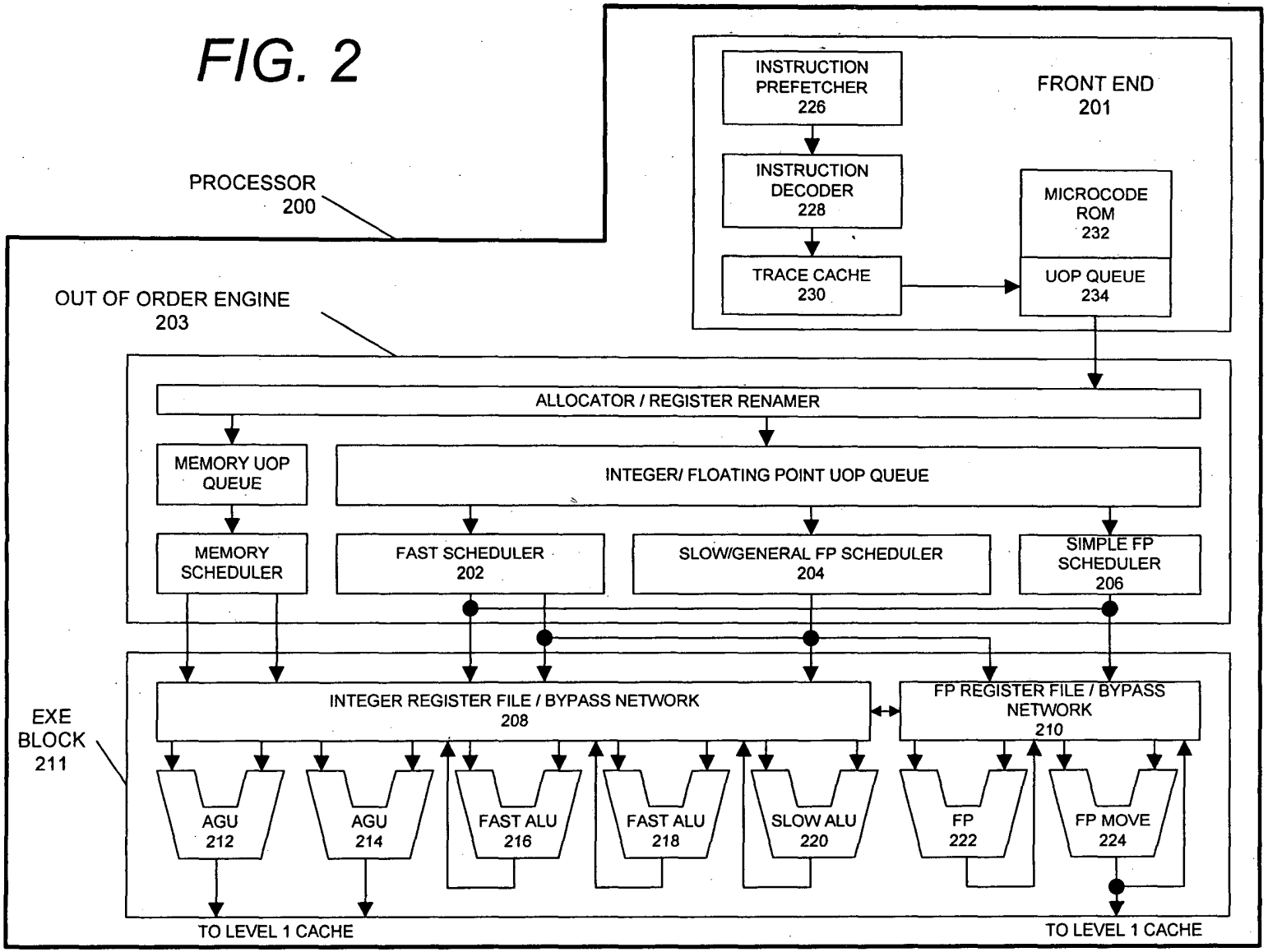

170
160
SIMD COPROCESSOR
161
163
164
162
165B
166
MAIN PROCESSOR
166
165
CACHE
167
I/O SYSTEM
168
WIRELESS
INTERFACE
169

FIG. 1C

FIG. 2


PROCESSOR
200
FRONT END
201
INSTRUCTION PREFETCHER
226
INSTRUCTION DECODER
228
TRACE CACHE
230
MICROCODE ROM
232
UOP QUEUE
234
OUT OF ORDER ENGINE
203
ALLOCATOR / REGISTER RENAMER
MEMORY UOP QUEUE
INTEGER/ FLOATING POINT UOP QUEUE
MEMORY SCHEDULER
FAST SCHEDULER
202
SLOW/GENERAL FP SCHEDULER
204
SIMPLE FP SCHEDULER
206
EXE BLOCK
211
INTEGER REGISTER FILE / BYPASS NETWORK
208
FP REGISTER FILE / BYPASS NETWORK
210
AGU
212
AGU
214
FAST ALU
216
FAST ALU
218
SLOW ALU
220
FP
222
FP MOVE
224
TO LEVEL 1 CACHE
TO LEVEL 1 CACHE

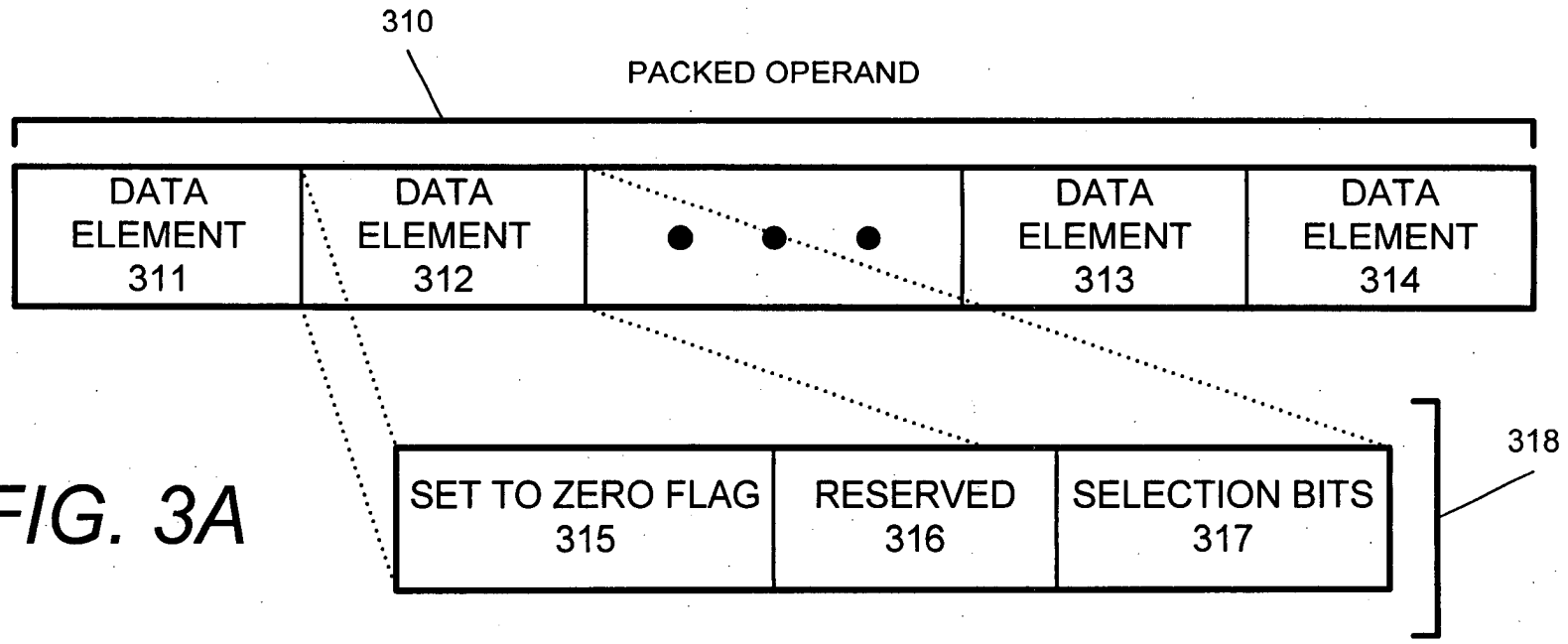


FIG. 3A

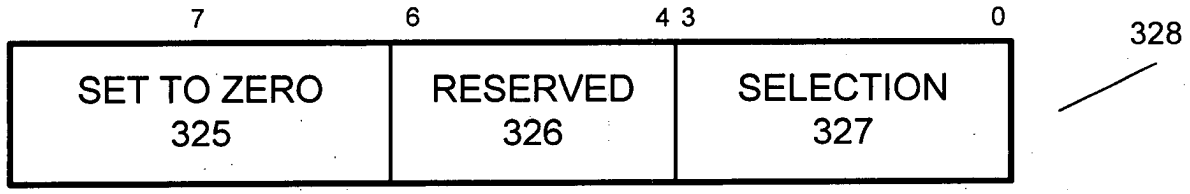


FIG. 3B

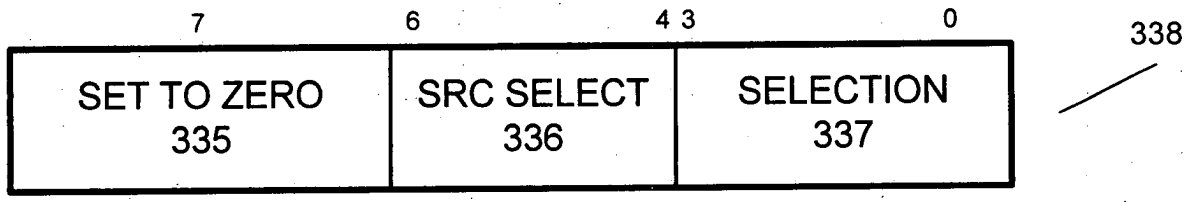


FIG. 3C

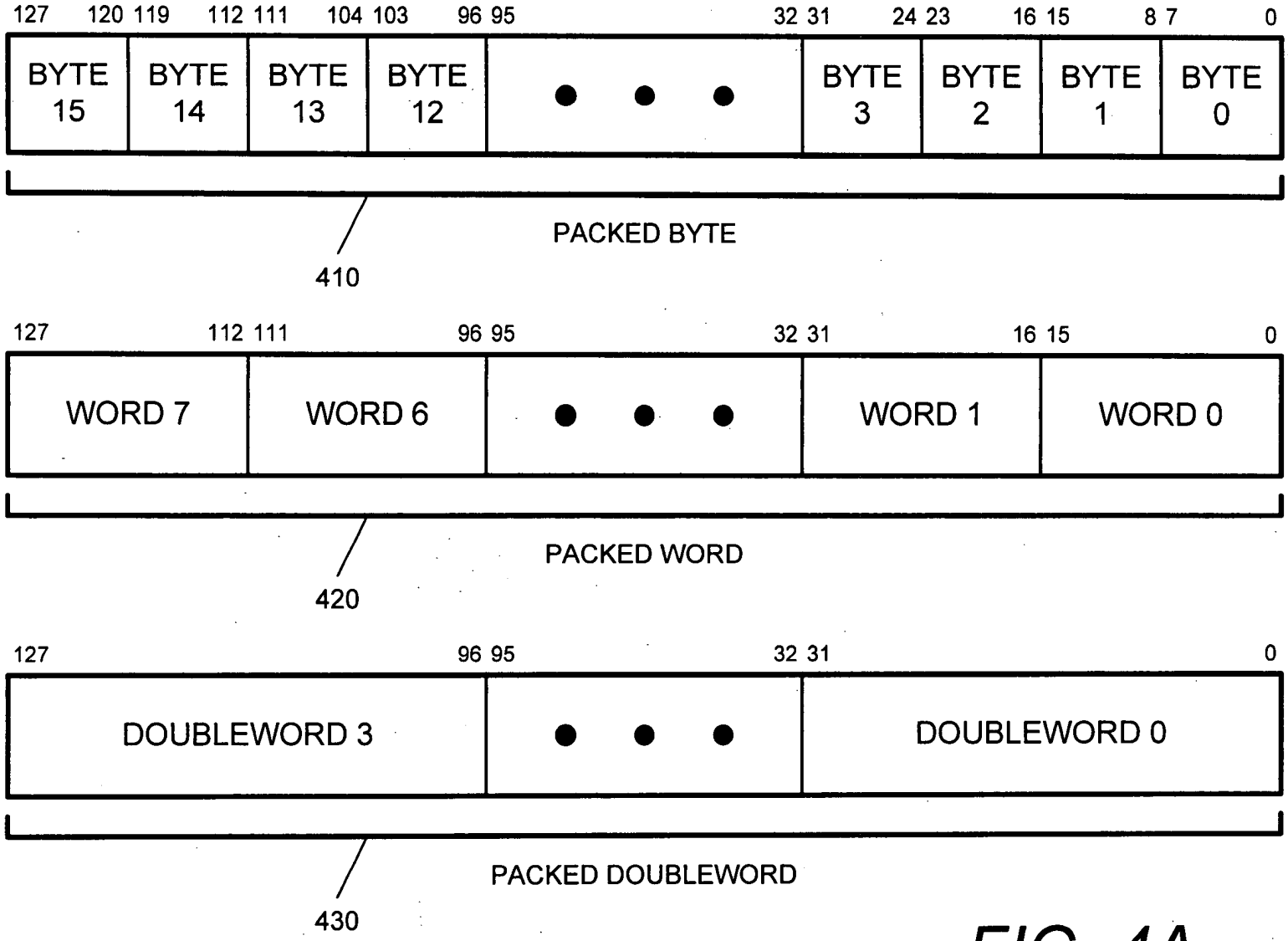

127 120 119 112 111 104 103 96 95 32 31 24 23 16 15 8 7 0
BYTE 15
BYTE 14
BYTE 13
BYTE 12
BYTE 3
BYTE 2
BYTE 1
BYTE 0
PACKED BYTE
410
127 112 111 96 95 32 31 16 15 0
WORD 7
WORD 6
WORD 1
WORD 0
PACKED WORD
420
127 96 95 32 31 0
DOUBLEWORD 3
DOUBLEWORD 0
PACKED DOUBLEWORD
430

FIG. 4A

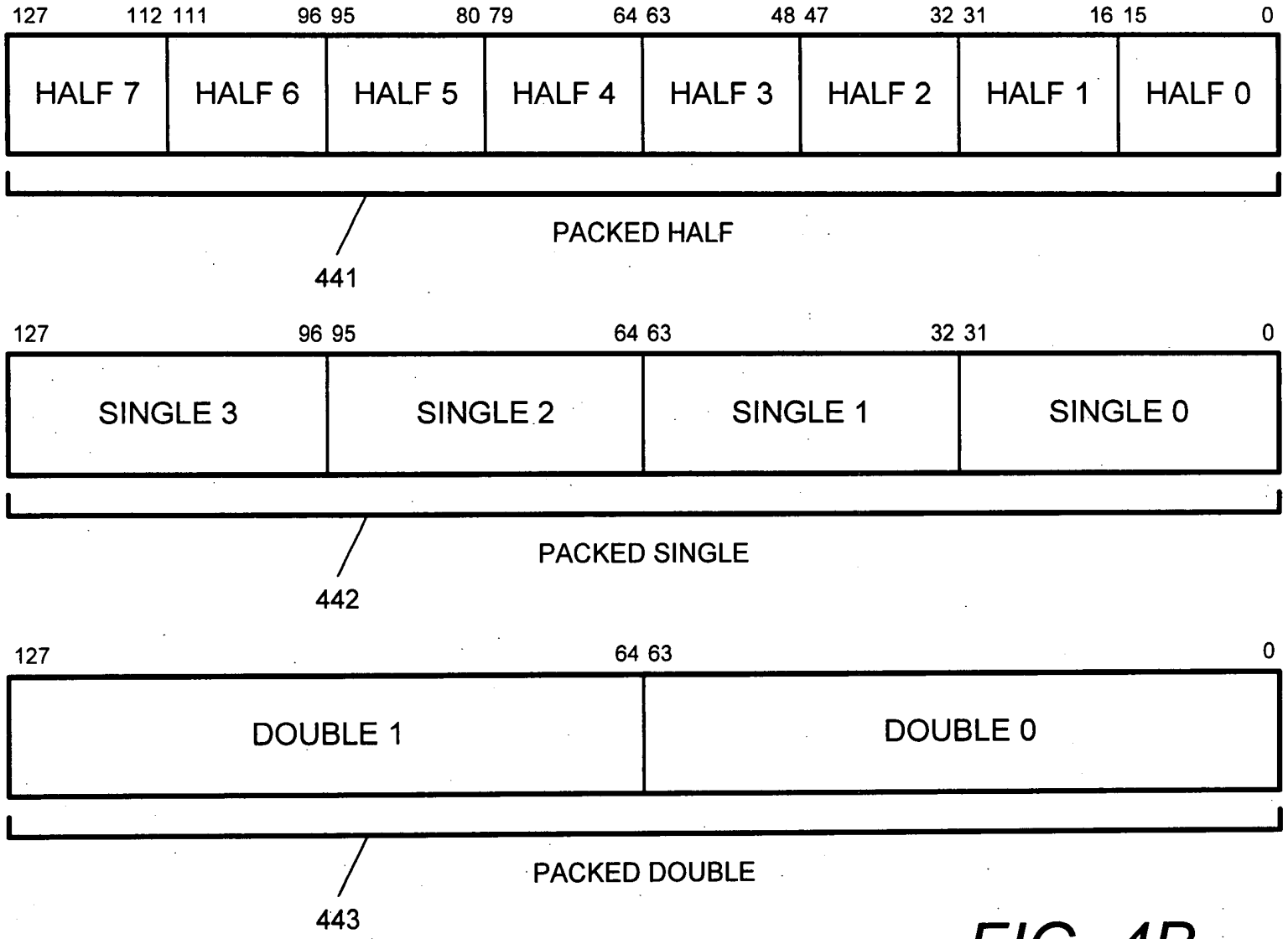

127
112 111
96 95
80 79
64 63
48 47
32 31
16 15
0
HALF 7
HALF 6
HALF 5
HALF 4
HALF 3
HALF 2
HALF 1
HALF 0
PACKED HALF
441
127
96 95
64 63
32 31
0
SINGLE 3
SINGLE 2
SINGLE 1
SINGLE 0
PACKED SINGLE
442
127
64 63
0
DOUBLE 1
DOUBLE 0
PACKED DOUBLE
443

FIG. 4B

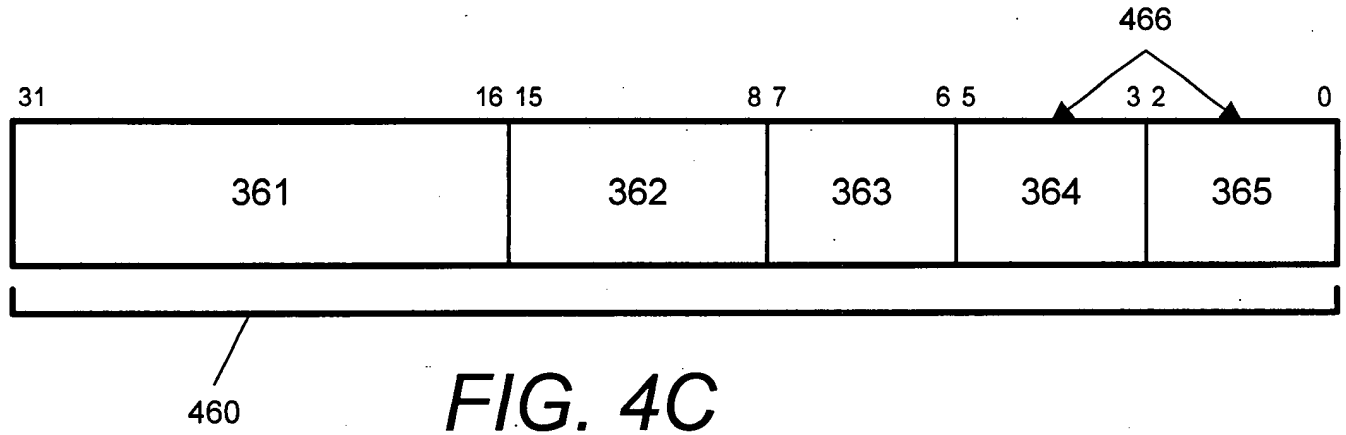

466
31
16 15
8 7
6 5
3 2
0
361
362
363
364
365
460

FIG. 4C

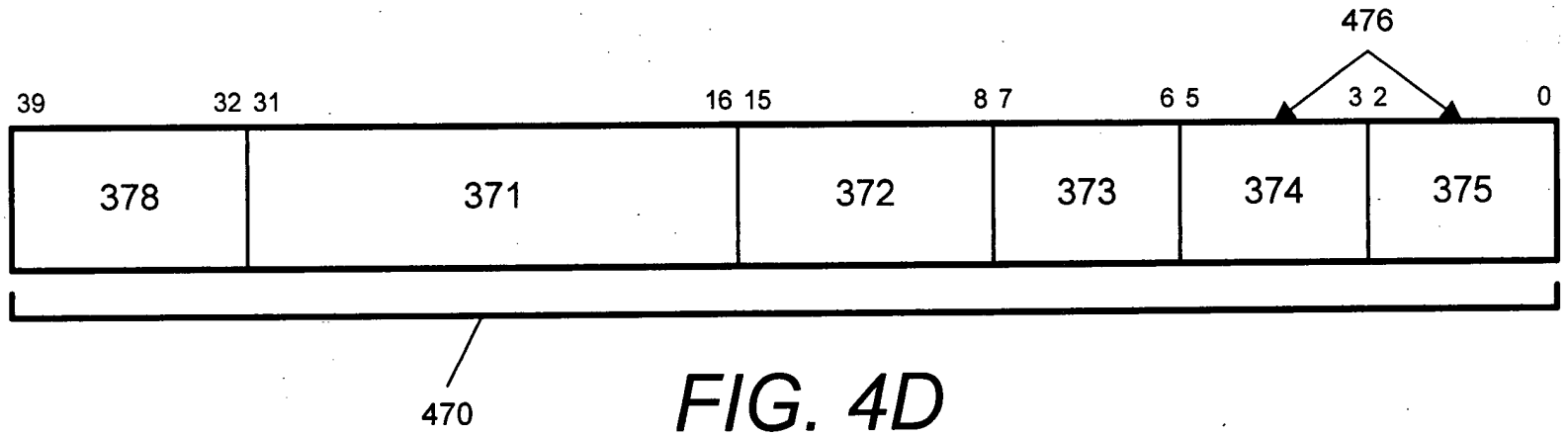

476
39
32 31
16 15
8 7
6 5
3 2
0
378
371
372
373
374
375
470

FIG. 4D

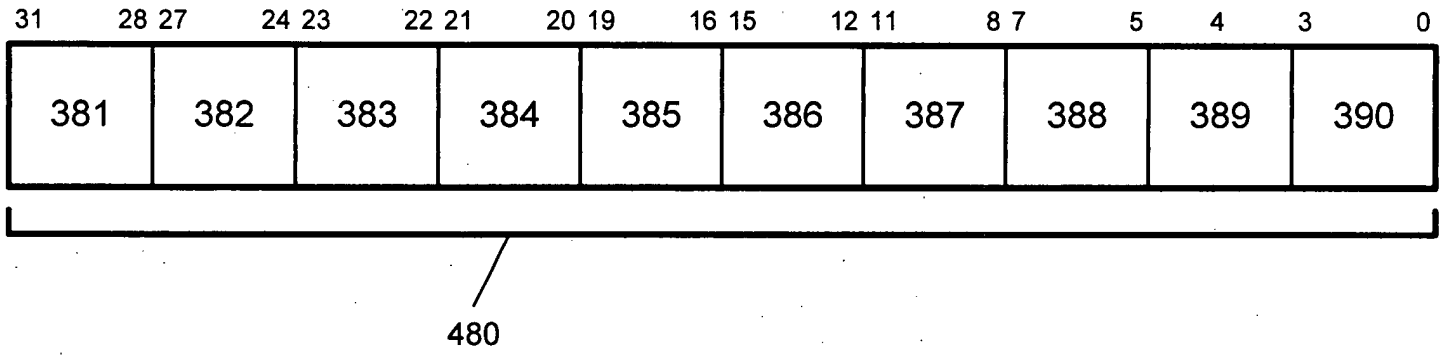

31
28 27
24 23
22 21
20 19
16 15
12 11
8 7
5
4
3
0
381
382
383
384
385
386
387
388
389
390
480

FIG. 4E

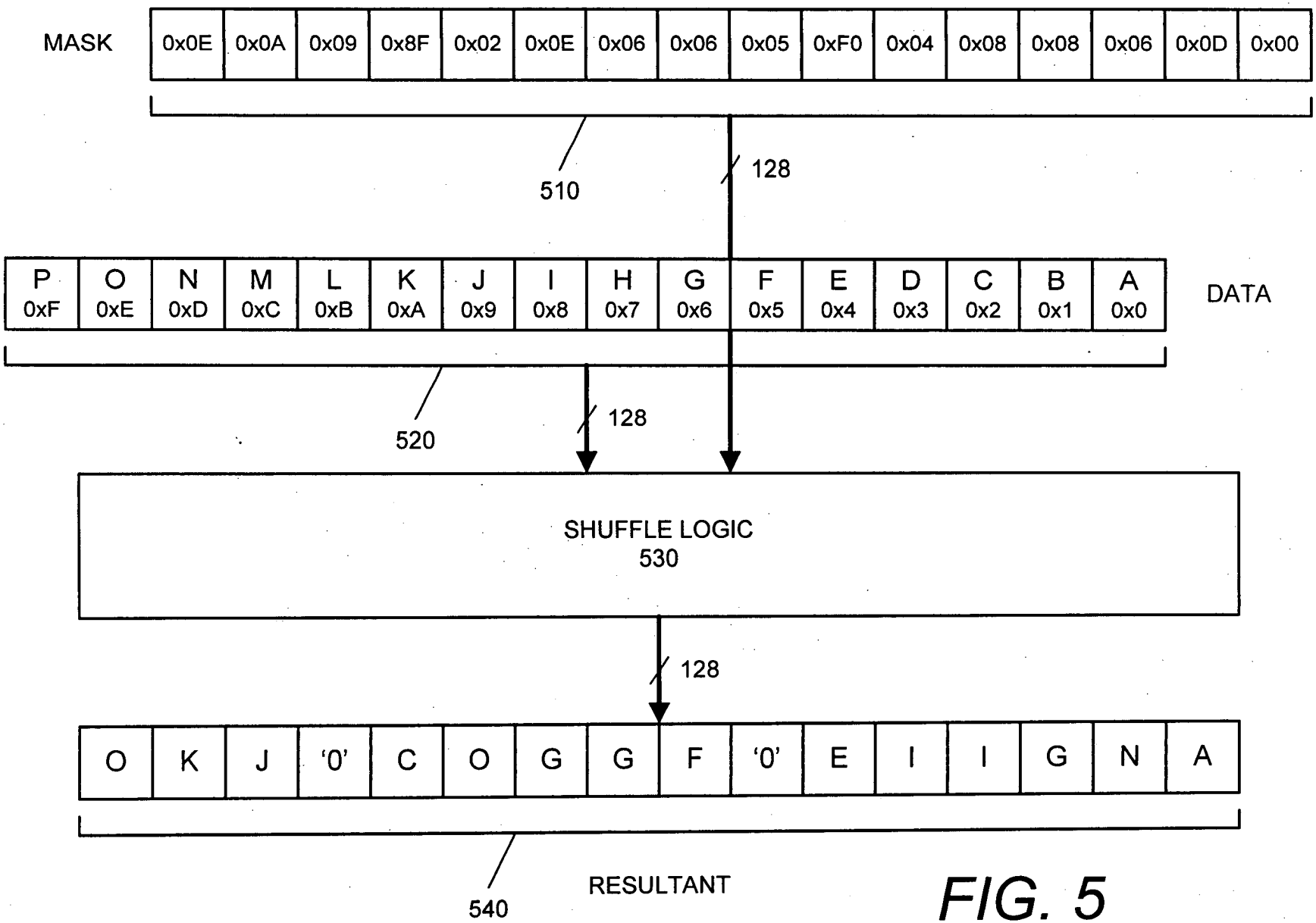
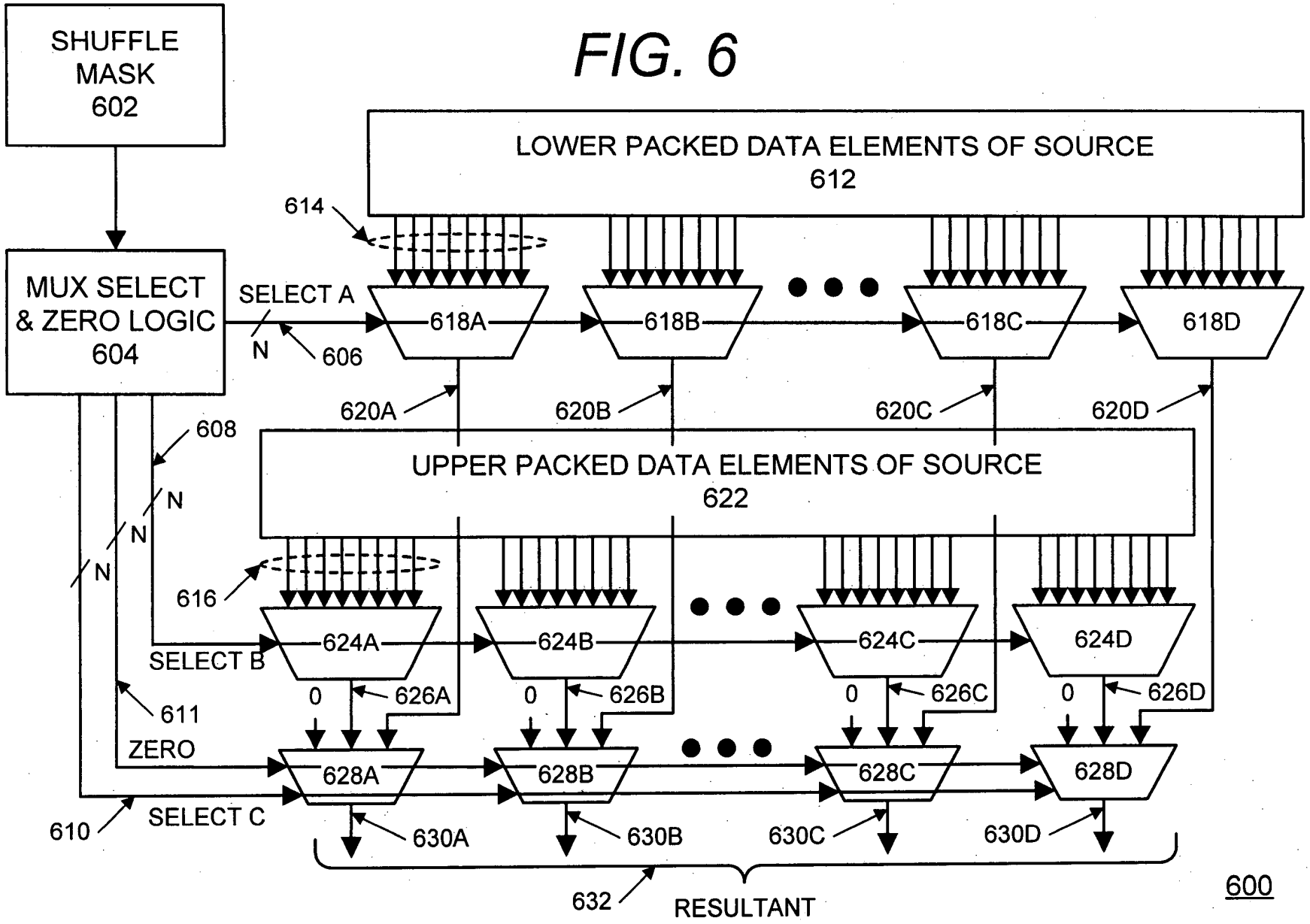

MASK
0x0E
0x0A
0x09
0x8F
0x02
0x0E
0x06
0x06
0x05
0xF0
0x04
0x08
0x08
0x06
0x0D
0x00
510
128
P 0xF
O 0xE
N 0xD
M 0xC
L 0xB
K 0xA
J 0x9
I 0x8
H 0x7
G 0x6
F 0x5
E 0x4
D 0x3
C 0x2
B 0x1
A 0x0
DATA
520
128
SHUFFLE LOGIC
530
128
O
K
J
'0'
C
O
G
G
F
'0'
E
I
I
G
N
A
RESULTANT
540

FIG. 5

FIG. 6


SHUFFLE MASK 602
MUX SELECT & ZERO LOGIC 604
LOWER PACKED DATA ELEMENTS OF SOURCE 612
UPPER PACKED DATA ELEMENTS OF SOURCE 622
614
SELECT A
N
606
618A
618B
618C
618D
620A
620B
620C
620D
608
N
N
N
616
624A
624B
624C
624D
SELECT B
0
626A
626B
626C
626D
611
ZERO
628A
628B
628C
628D
610
SELECT C
630A
630B
630C
630D
632
RESULTANT
600

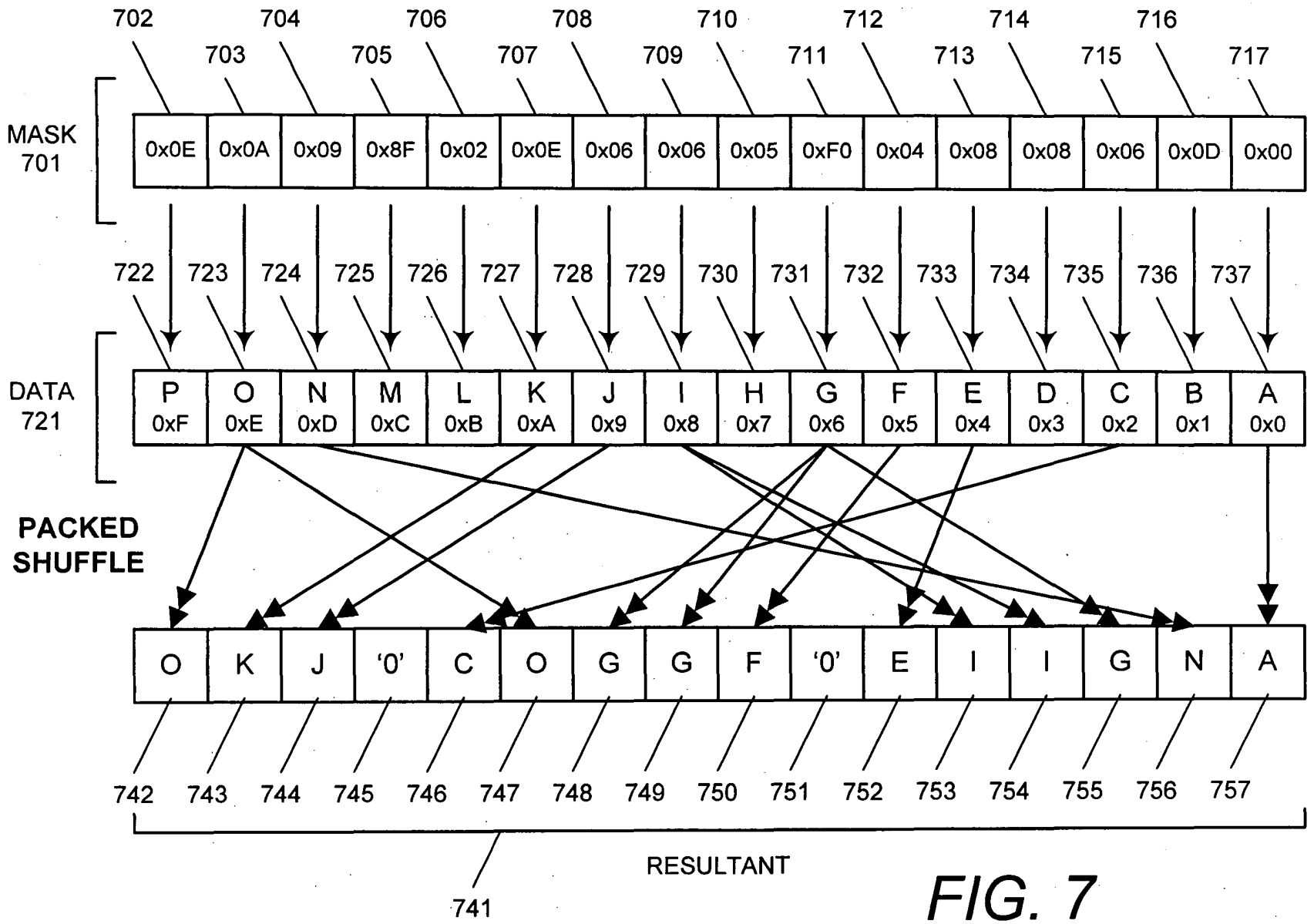

MASK
701
0x0E 0x0A 0x09 0x8F 0x02 0x0E 0x06 0x06 0x05 0xF0 0x04 0x08 0x08 0x06 0x0D 0x00
DATA
721
P 0xF
O 0xE
N 0xD
M 0xC
L 0xB
K 0xA
J 0x9
I 0x8
H 0x7
G 0x6
F 0x5
E 0x4
D 0x3
C 0x2
B 0x1
A 0x0
PACKED
SHUFFLE
O K J '0' C O G G F '0' E I I G N A
RESULTANT
741

FIG. 7

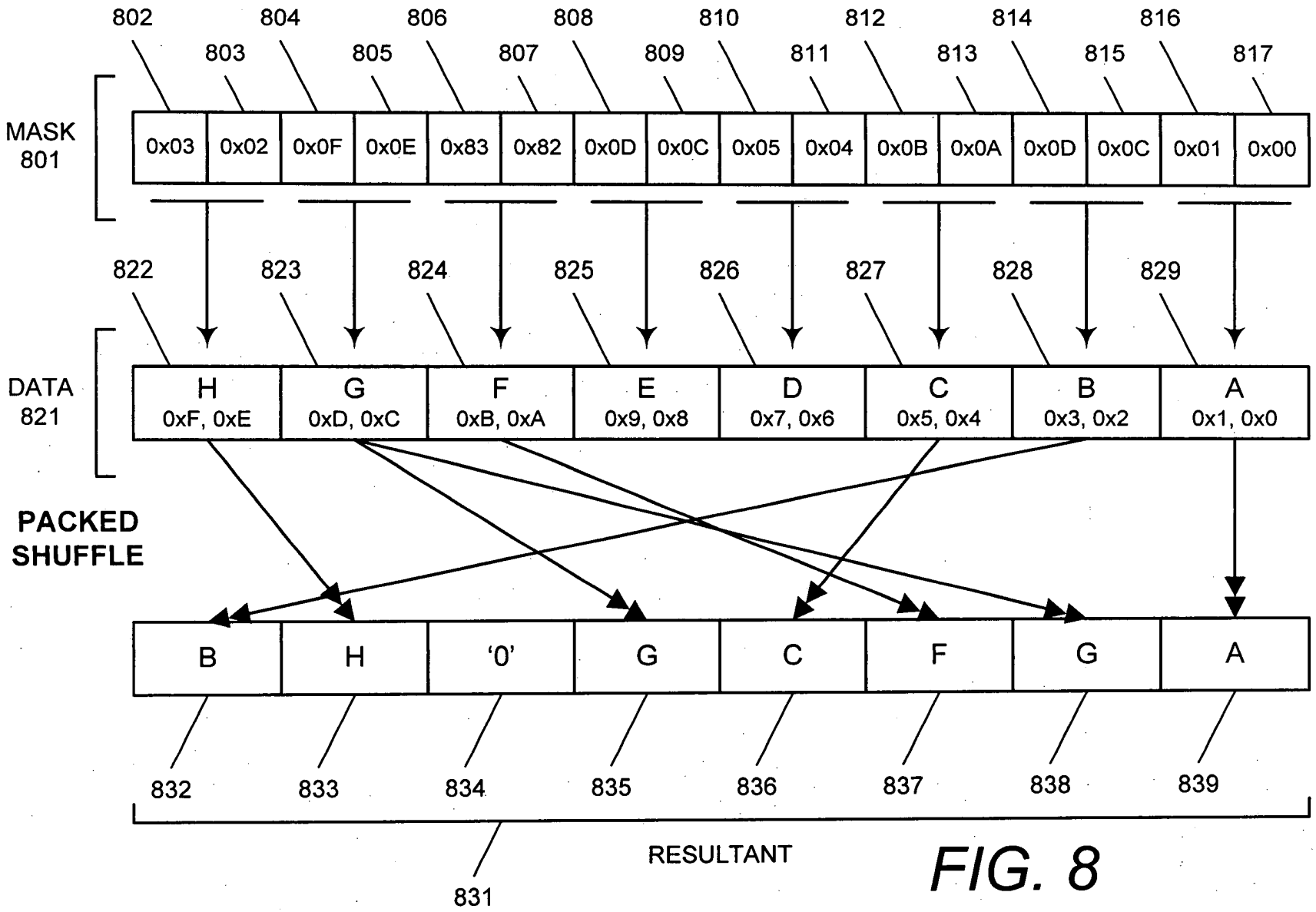
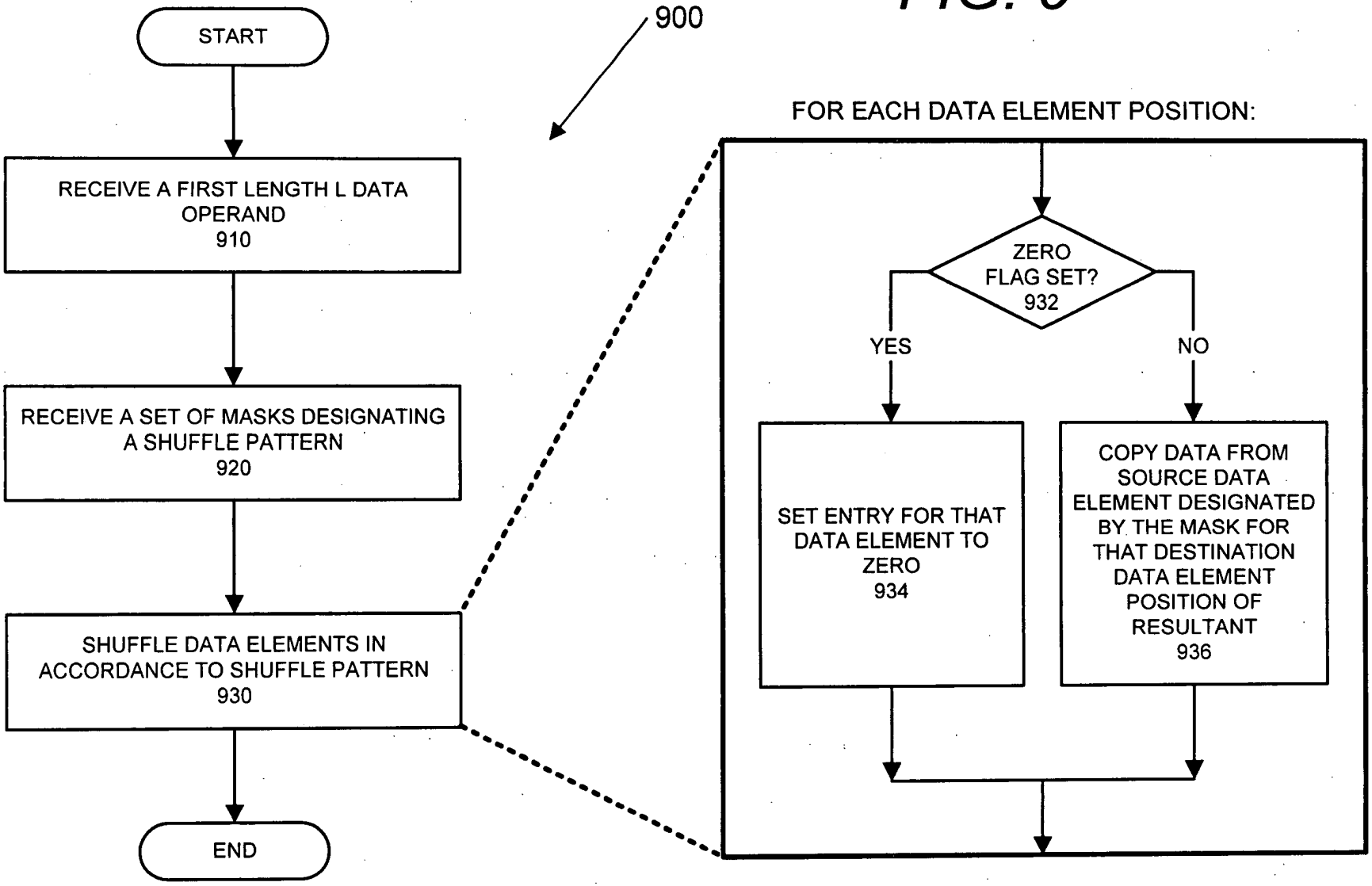

802
804
806
808
810
812
814
816
803
805
807
809
811
813
815
817
MASK
801
0x03
0x02
0x0F
0x0E
0x83
0x82
0x0D
0x0C
0x05
0x04
0x0B
0x0A
0x0D
0x0C
0x01
0x00
822
823
824
825
826
827
828
829
DATA
821
H
0xF, 0xE
G
0xD, 0xC
F
0xB, 0xA
E
0x9, 0x8
D
0x7, 0x6
C
0x5, 0x4
B
0x3, 0x2
A
0x1, 0x0
PACKED
SHUFFLE
B
H
'0'
G
C
F
G
A
832
833
834
835
836
837
838
839
RESULTANT
831

FIG. 8

FIG. 9


900
START
RECEIVE A FIRST LENGTH L DATA OPERAND
910
RECEIVE A SET OF MASKS DESIGNATING A SHUFFLE PATTERN
920
SHUFFLE DATA ELEMENTS IN ACCORDANCE TO SHUFFLE PATTERN
930
END
FOR EACH DATA ELEMENT POSITION:
ZERO FLAG SET?
932
YES
NO
SET ENTRY FOR THAT DATA ELEMENT TO ZERO
934
COPY DATA FROM SOURCE DATA ELEMENT DESIGNATED BY THE MASK FOR THAT DESTINATION DATA ELEMENT POSITION OF RESULTANT
936

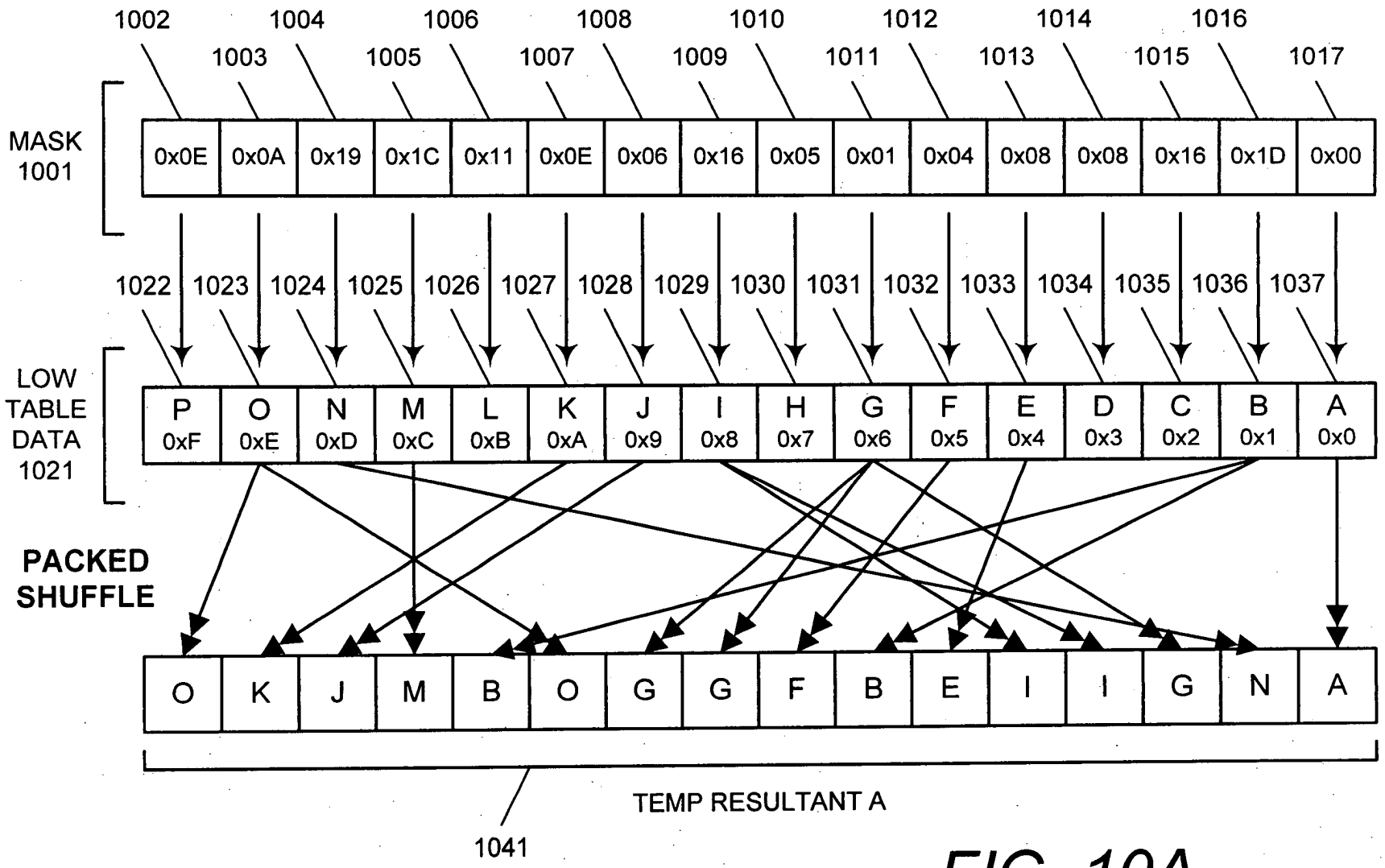

1002
1003
1004
1005
1006
1007
1008
1009
1010
1011
1012
1013
1014
1015
1016
1017
MASK
1001
0x0E
0x0A
0x19
0x1C
0x11
0x0E
0x06
0x16
0x05
0x01
0x04
0x08
0x08
0x16
0x1D
0x00
1022
1023
1024
1025
1026
1027
1028
1029
1030
1031
1032
1033
1034
1035
1036
1037
LOW
TABLE
DATA
1021
P 0xF
O 0xE
N 0xD
M 0xC
L 0xB
K 0xA
J 0x9
I 0x8
H 0x7
G 0x6
F 0x5
E 0x4
D 0x3
C 0x2
B 0x1
A 0x0
PACKED
SHUFFLE
O
K
J
M
B
O
G
G
F
B
E
I
I
G
N
A
TEMP RESULTANT A
1041

FIG. 10A

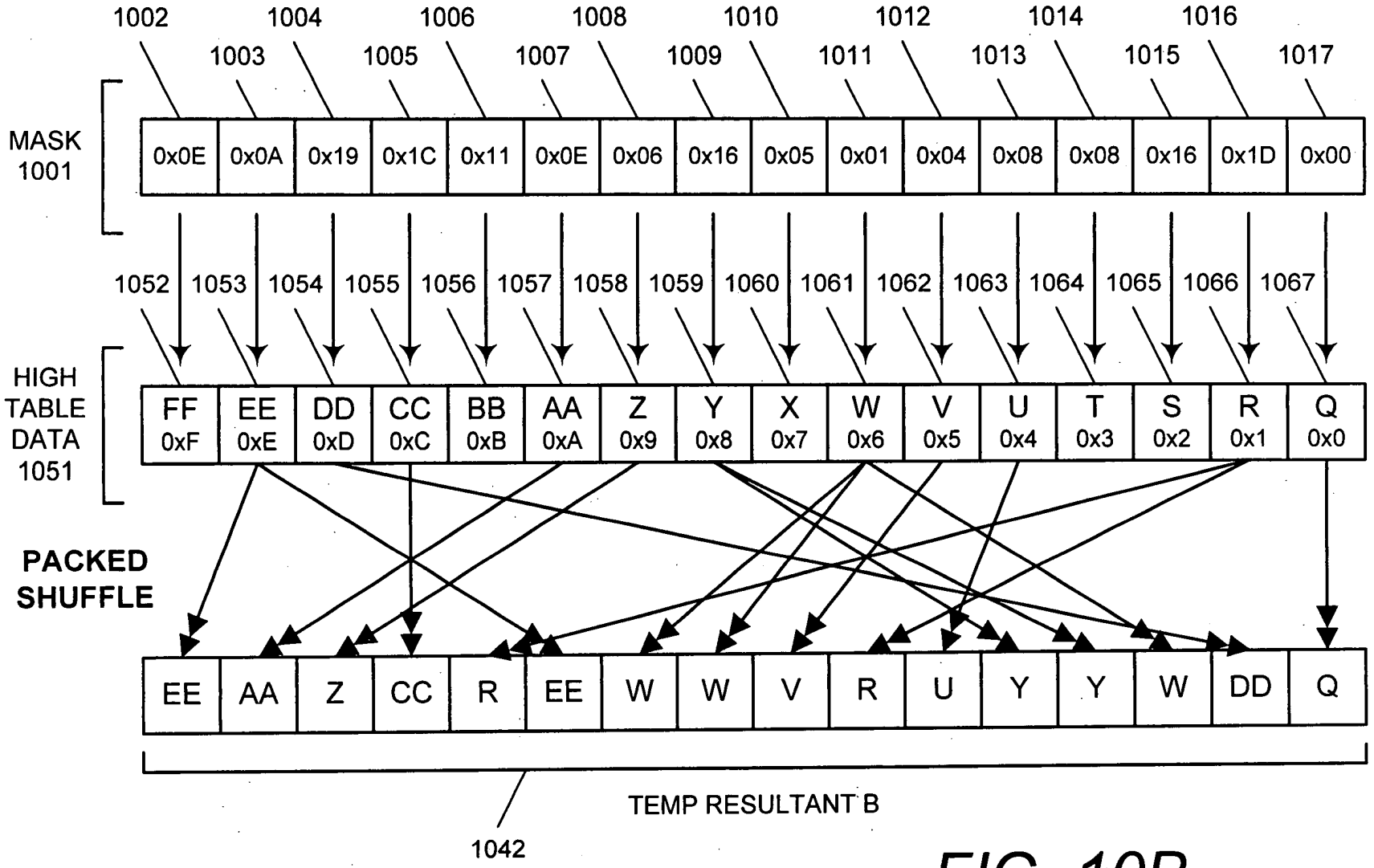

1002
1003
1004
1005
1006
1007
1008
1009
1010
1011
1012
1013
1014
1015
1016
1017
MASK
1001
0x0E
0x0A
0x19
0x1C
0x11
0x0E
0x06
0x16
0x05
0x01
0x04
0x08
0x08
0x16
0x1D
0x00
1052
1053
1054
1055
1056
1057
1058
1059
1060
1061
1062
1063
1064
1065
1066
1067
HIGH
TABLE
DATA
1051
FF 0xF
EE 0xE
DD 0xD
CC 0xC
BB 0xB
AA 0xA
Z 0x9
Y 0x8
X 0x7
W 0x6
V 0x5
U 0x4
T 0x3
S 0x2
R 0x1
Q 0x0
PACKED
SHUFFLE
EE
AA
Z
CC
R
EE
W
W
V
R
U
Y
Y
W
DD
Q
TEMP RESULTANT B
1042

FIG. 10B

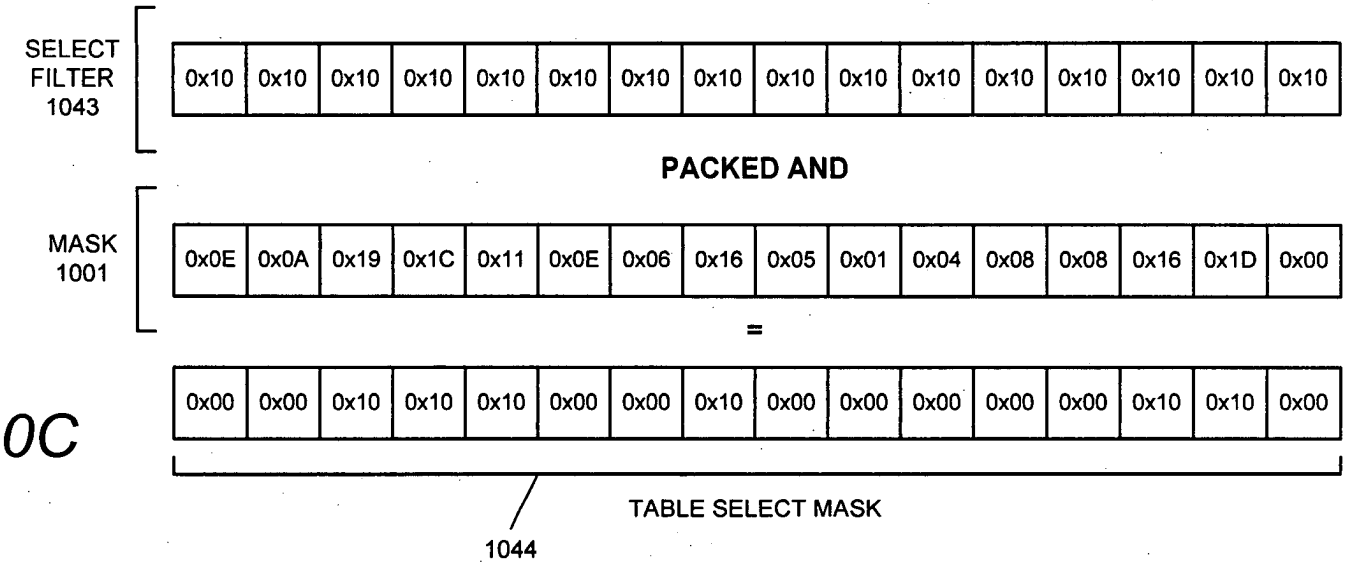


FIG. 10C

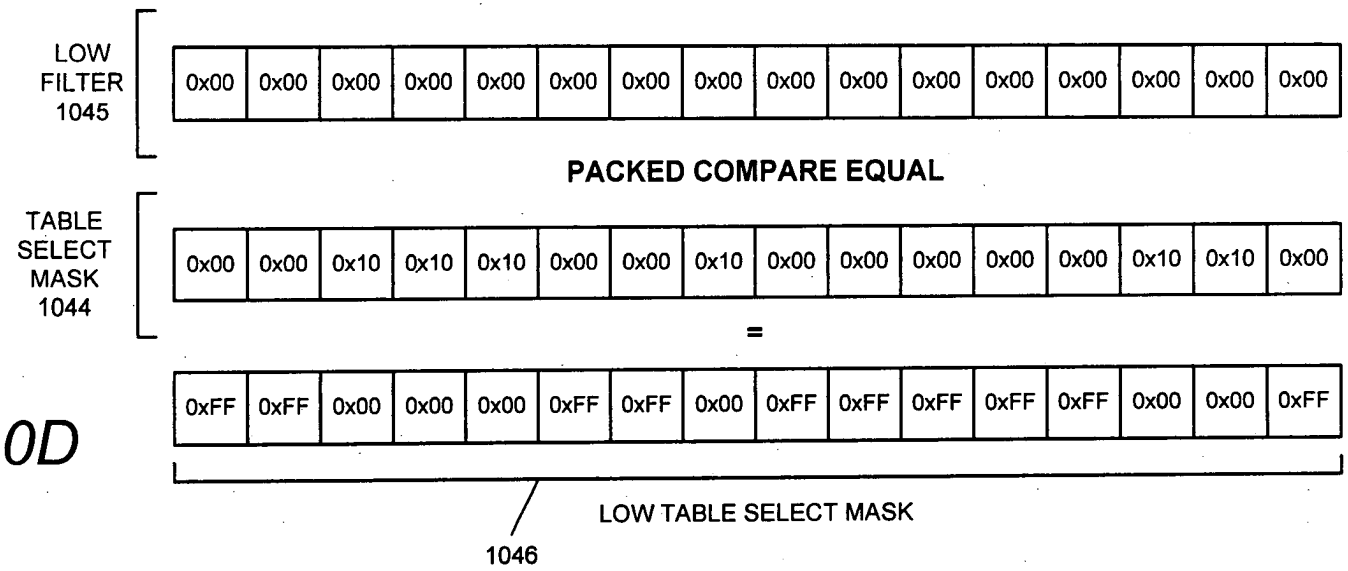


FIG. 10D

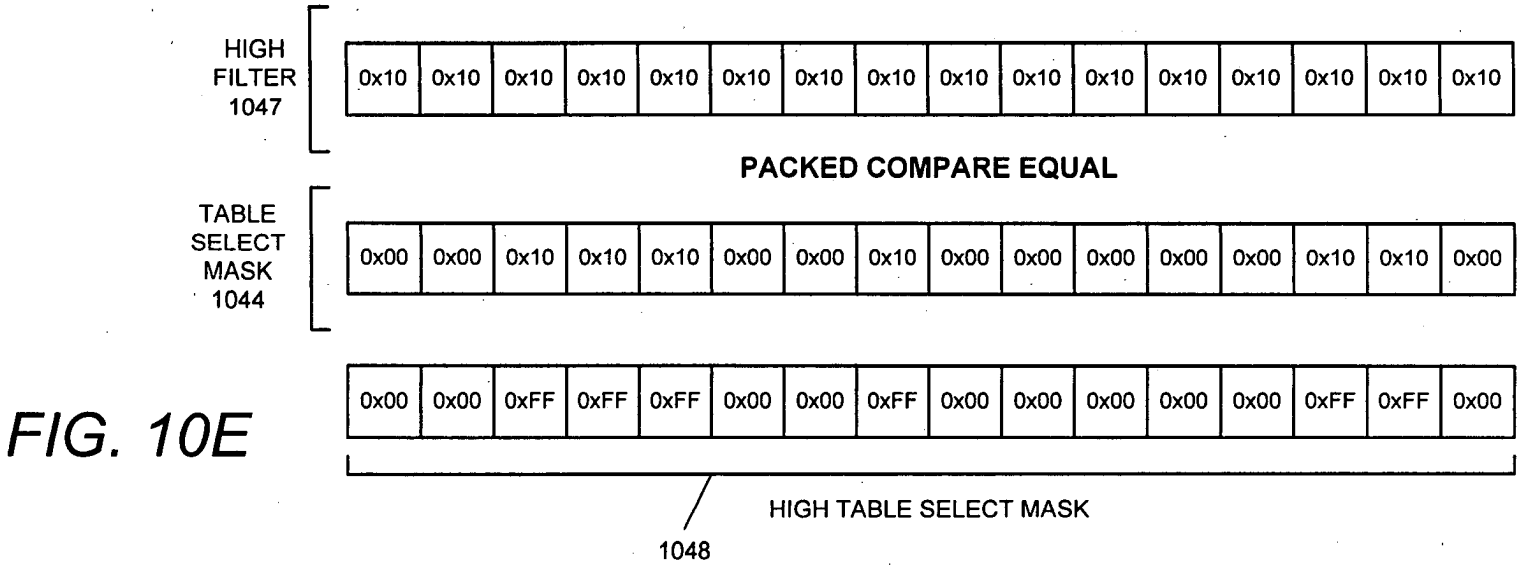


FIG. 10E

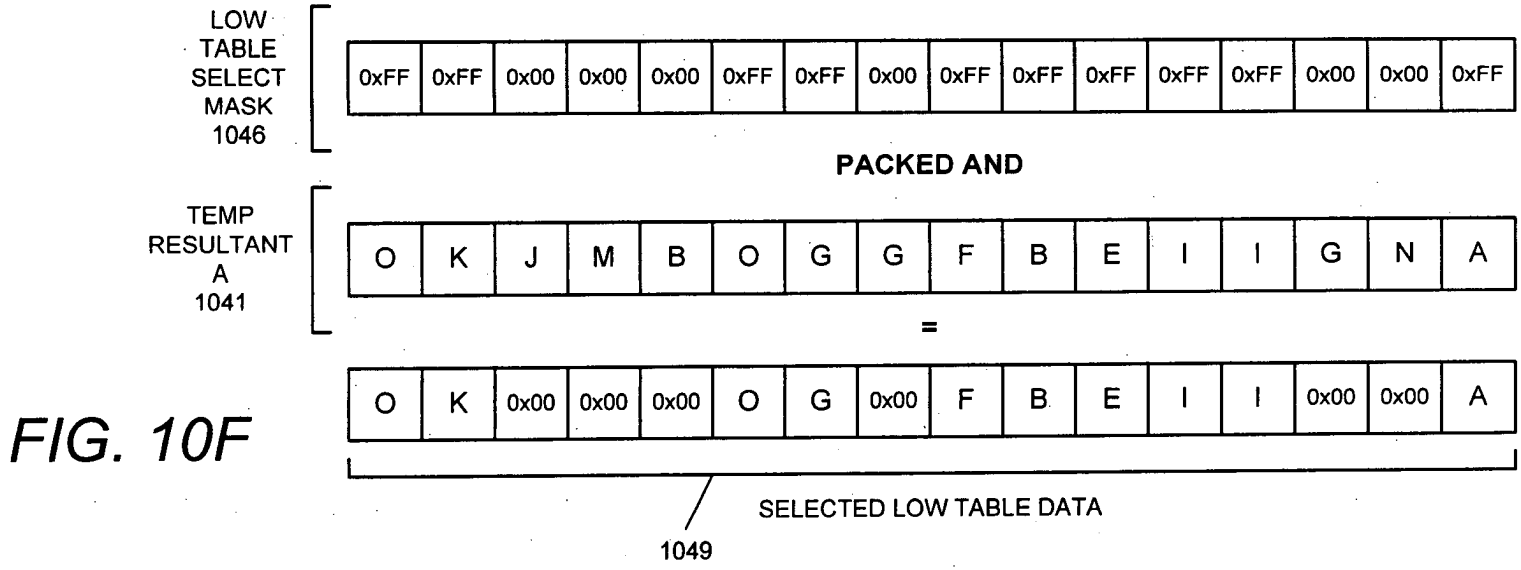


FIG. 10F

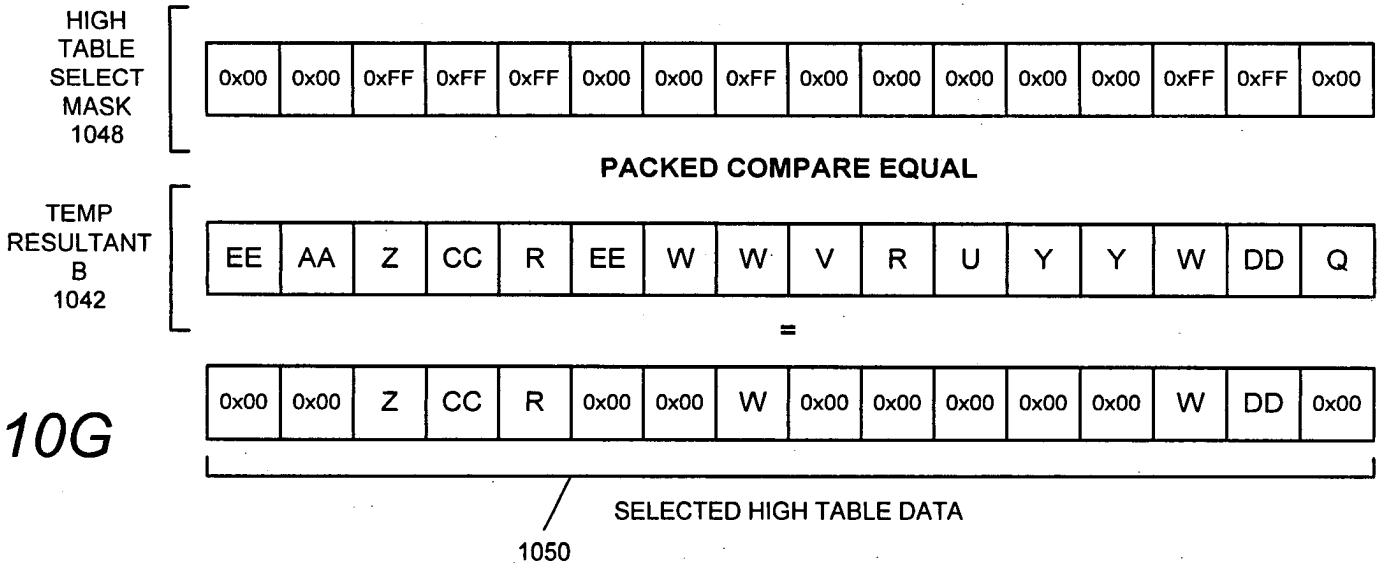


FIG. 10G

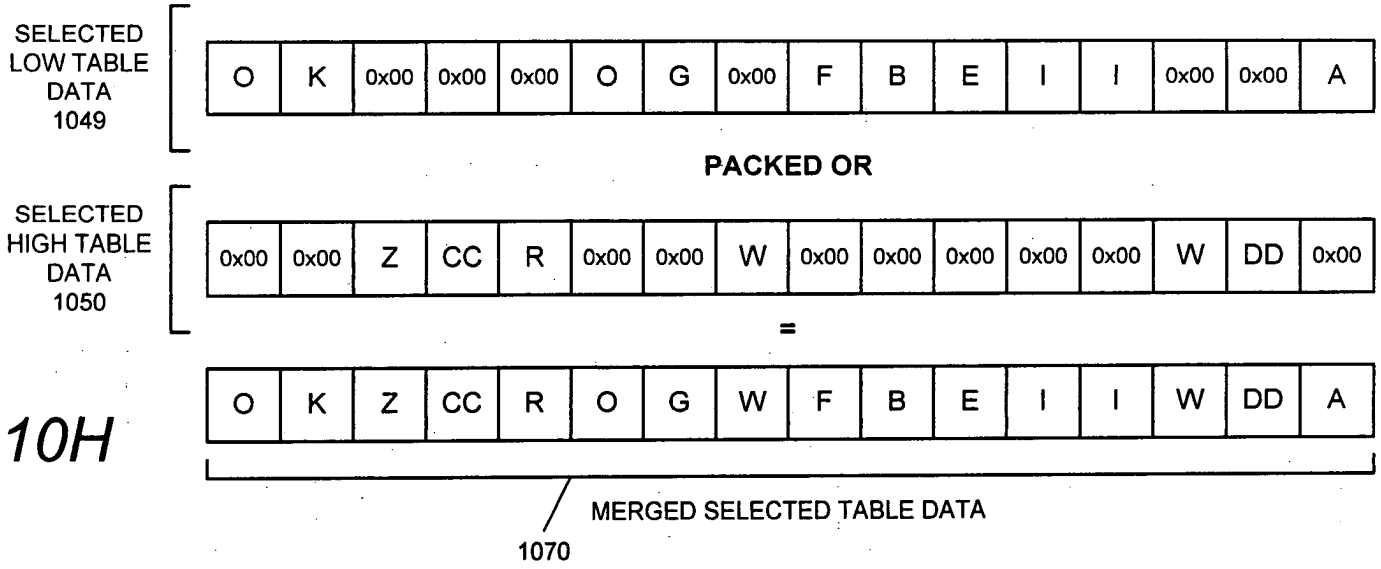


FIG. 10H

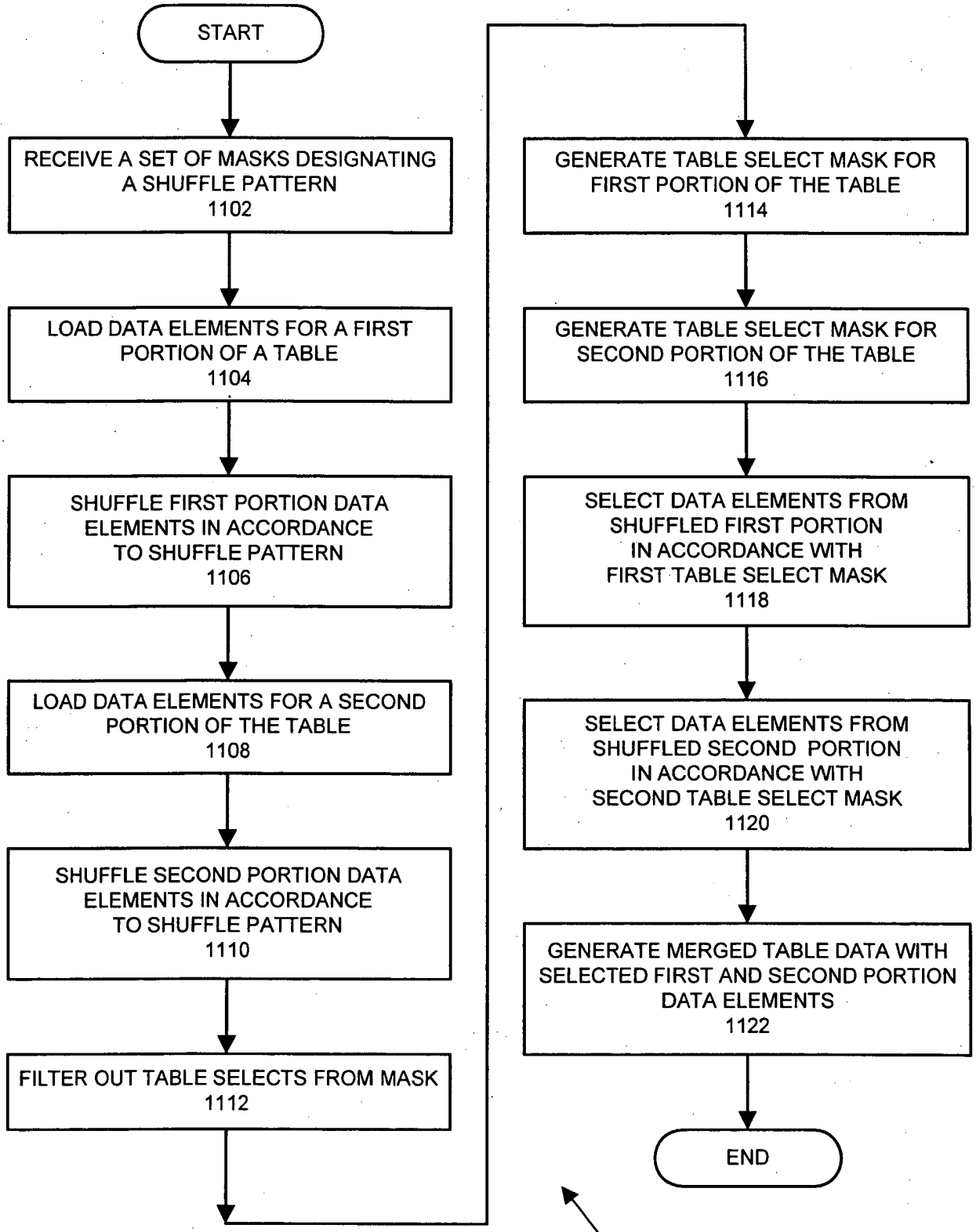

START
RECEIVE A SET OF MASKS DESIGNATING A SHUFFLE PATTERN
1102
LOAD DATA ELEMENTS FOR A FIRST PORTION OF A TABLE
1104
SHUFFLE FIRST PORTION DATA ELEMENTS IN ACCORDANCE TO SHUFFLE PATTERN
1106
LOAD DATA ELEMENTS FOR A SECOND PORTION OF THE TABLE
1108
SHUFFLE SECOND PORTION DATA ELEMENTS IN ACCORDANCE TO SHUFFLE PATTERN
1110
FILTER OUT TABLE SELECTS FROM MASK
1112
GENERATE TABLE SELECT MASK FOR FIRST PORTION OF THE TABLE
1114
GENERATE TABLE SELECT MASK FOR SECOND PORTION OF THE TABLE
1116
SELECT DATA ELEMENTS FROM SHUFFLED FIRST PORTION IN ACCORDANCE WITH FIRST TABLE SELECT MASK
1118
SELECT DATA ELEMENTS FROM SHUFFLED SECOND PORTION IN ACCORDANCE WITH SECOND TABLE SELECT MASK
1120
GENERATE MERGED TABLE DATA WITH SELECTED FIRST AND SECOND PORTION DATA ELEMENTS
1122
END
1100

FIG. 11

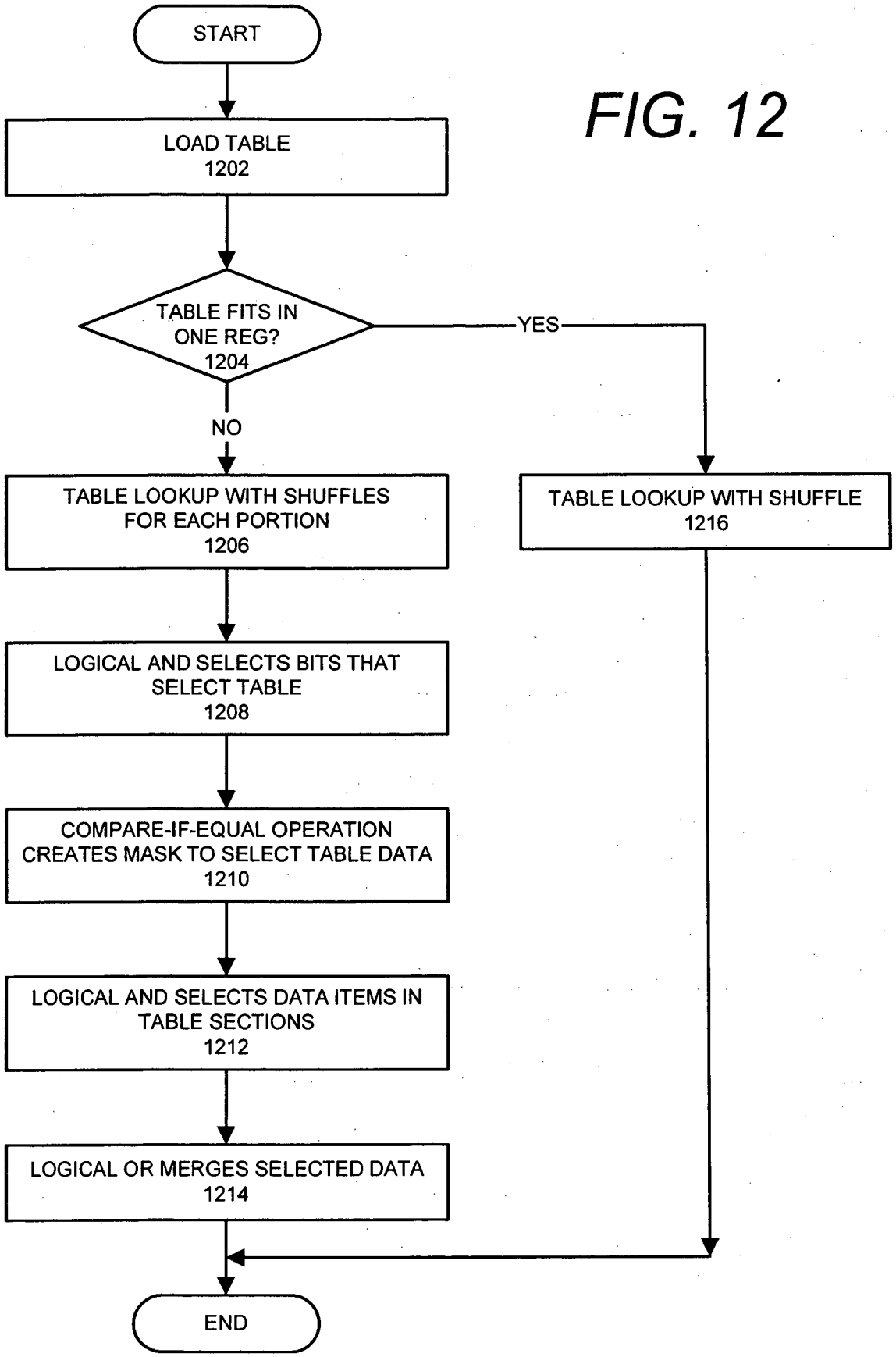

START
LOAD TABLE
1202
TABLE FITS IN ONE REG?
1204
YES
NO
TABLE LOOKUP WITH SHUFFLES FOR EACH PORTION
1206
TABLE LOOKUP WITH SHUFFLE
1216
LOGICAL AND SELECTS BITS THAT SELECT TABLE
1208
COMPARE-IF-EQUAL OPERATION CREATES MASK TO SELECT TABLE DATA
1210
LOGICAL AND SELECTS DATA ITEMS IN TABLE SECTIONS
1212
LOGICAL OR MERGES SELECTED DATA
1214
END

FIG. 12

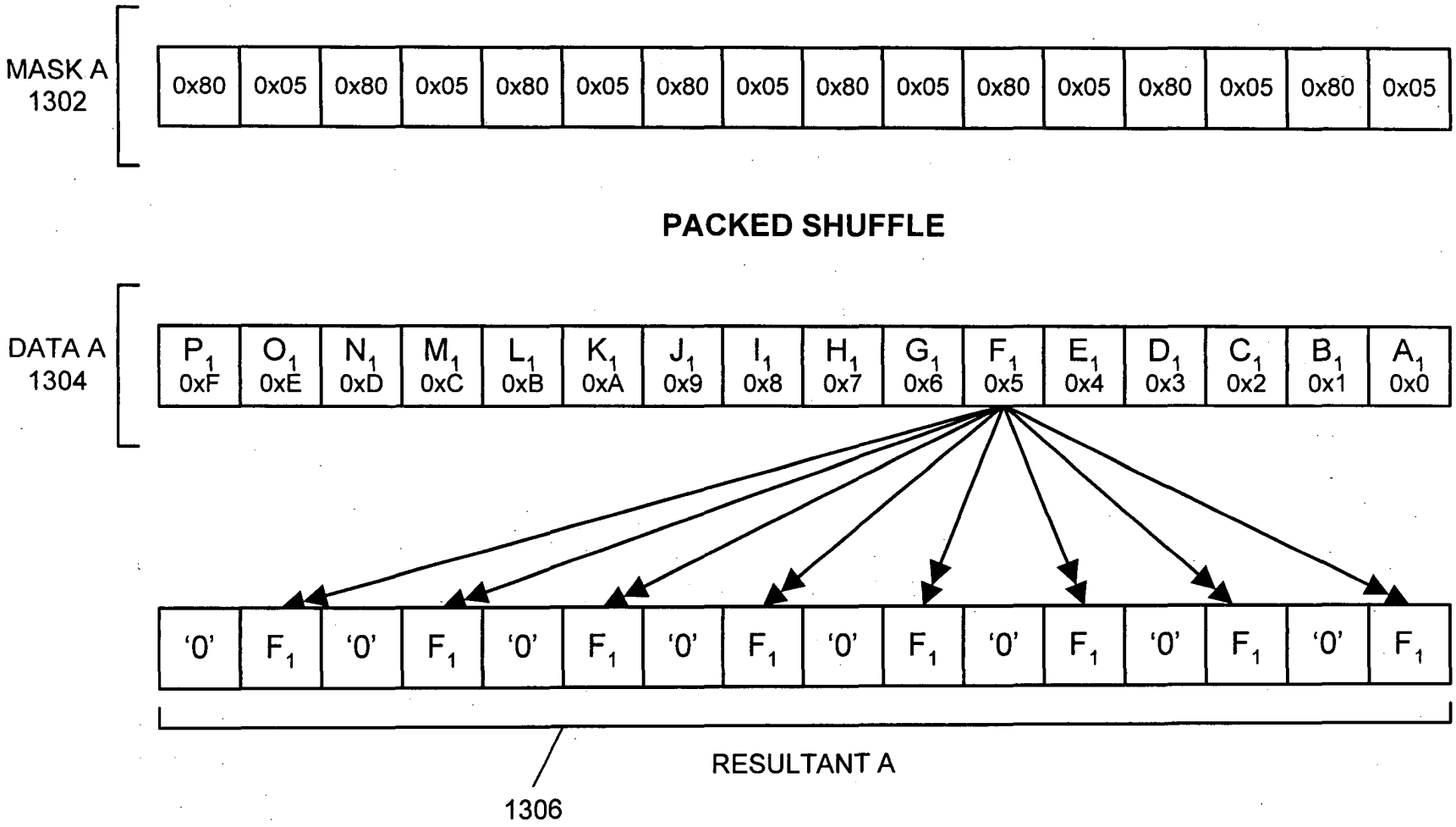

MASK A
1302
0x80 0x05 0x80 0x05 0x80 0x05 0x80 0x05 0x80 0x05 0x80 0x05 0x80 0x05 0x80 0x05
PACKED SHUFFLE
DATA A
1304
P1 0xF
O1 0xE
N1 0xD
M1 0xC
L1 0xB
K1 0xA
J1 0x9
I1 0x8
H1 0x7
G1 0x6
F1 0x5
E1 0x4
D1 0x3
C1 0x2
B1 0x1
A1 0x0
'0' F1 '0' F1 '0' F1 '0' F1 '0' F1 '0' F1 '0' F1 '0' F1
RESULTANT A
1306

FIG. 13A

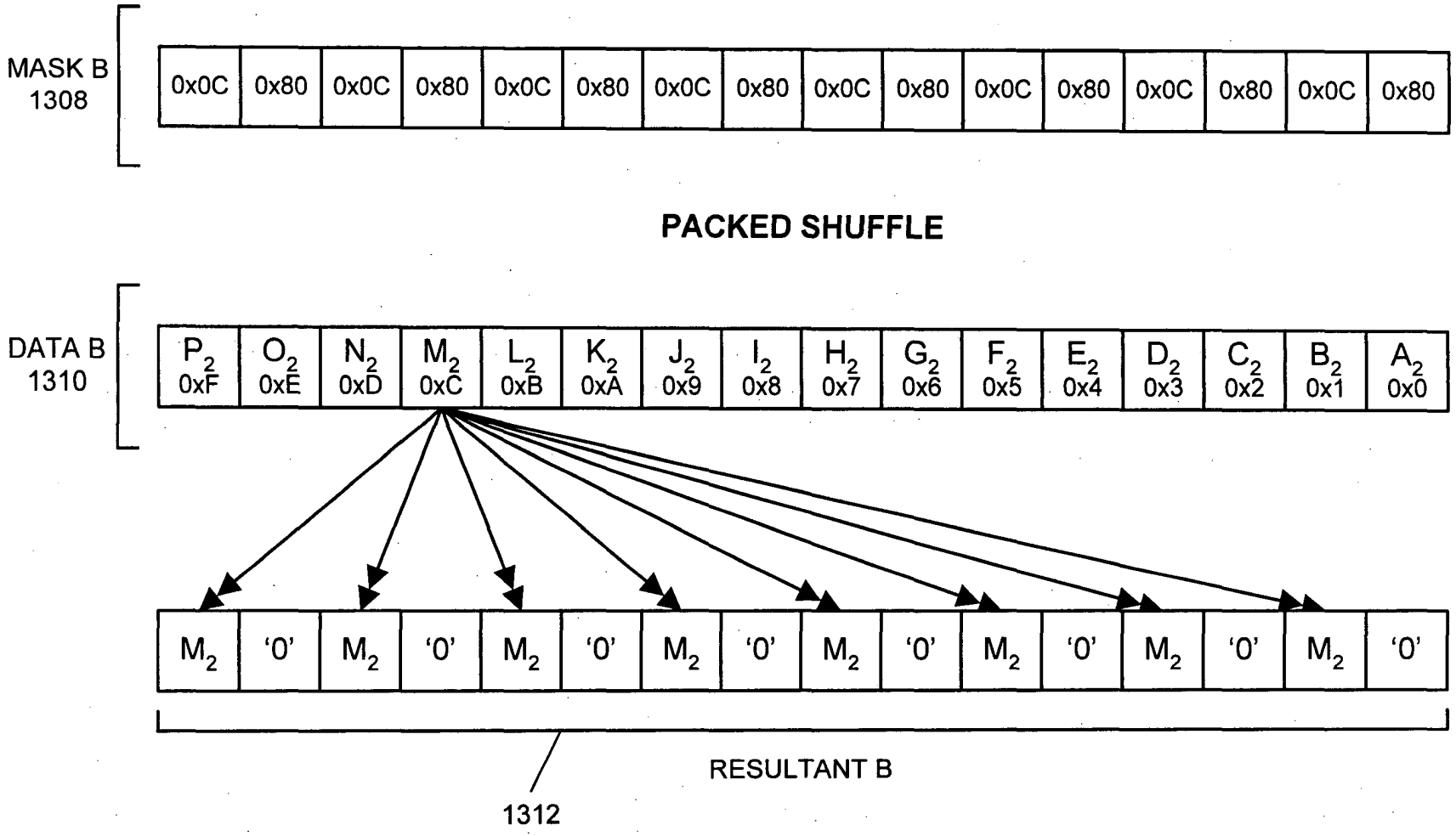

MASK B
1308
0x0C 0x80 0x0C 0x80 0x0C 0x80 0x0C 0x80 0x0C 0x80 0x0C 0x80 0x0C 0x80 0x0C 0x80
PACKED SHUFFLE
DATA B
1310
P2 0xF
O2 0xE
N2 0xD
M2 0xC
L2 0xB
K2 0xA
J2 0x9
I2 0x8
H2 0x7
G2 0x6
F2 0x5
E2 0x4
D2 0x3
C2 0x2
B2 0x1
A2 0x0
M2 '0' M2 '0' M2 '0' M2 '0' M2 '0' M2 '0' M2 '0' M2 '0' M2 '0'
RESULTANT B
1312

FIG. 13B

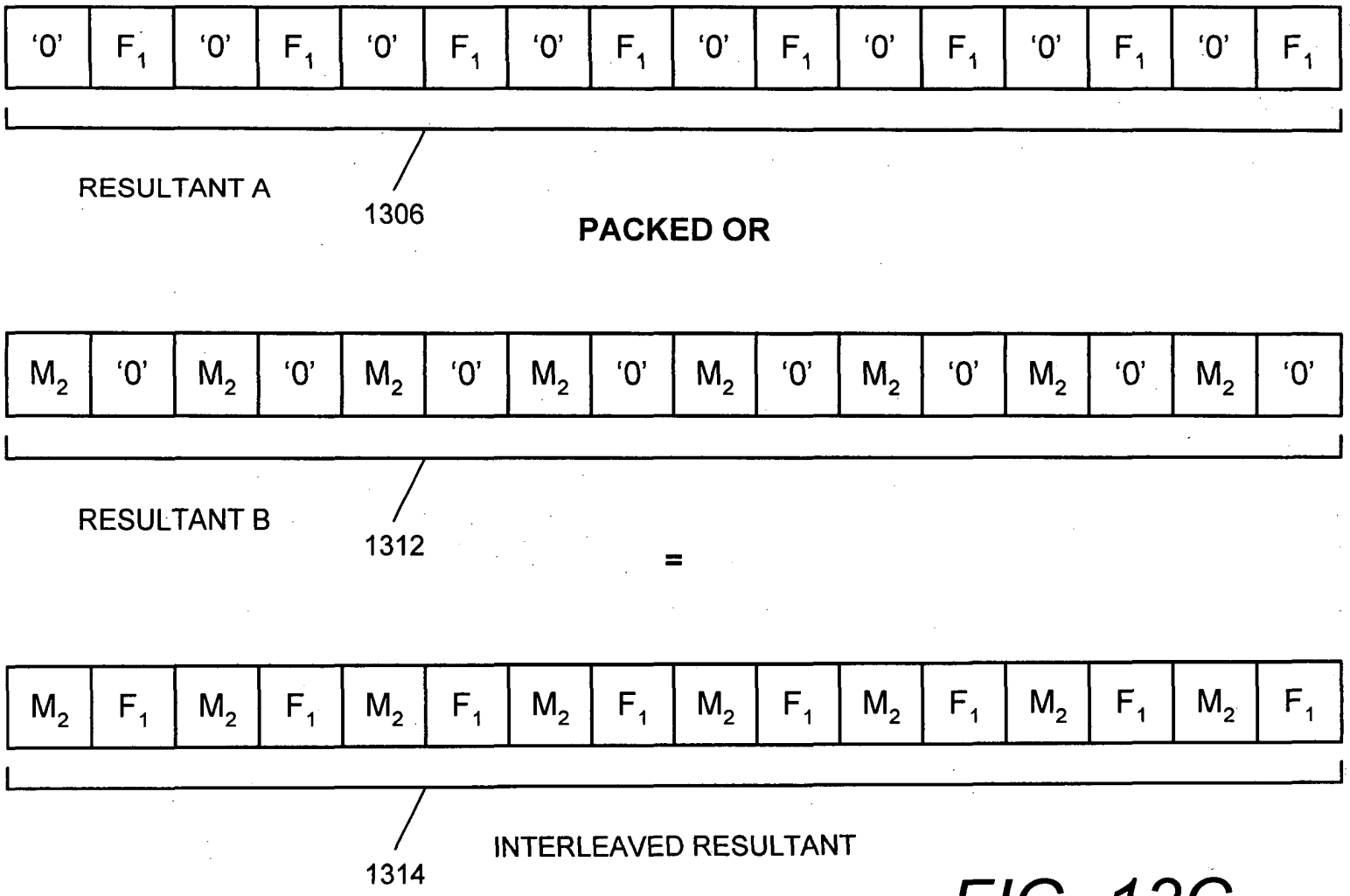

'0' F1 '0' F1 '0' F1 '0' F1 '0' F1 '0' F1 '0' F1 '0' F1
RESULTANT A
1306
PACKED OR
M2 '0' M2 '0' M2 '0' M2 '0' M2 '0' M2 '0' M2 '0' M2 '0'
RESULTANT B
1312
=
M2 F1 M2 F1 M2 F1 M2 F1 M2 F1 M2 F1 M2 F1 M2 F1
1314
INTERLEAVED RESULTANT

FIG. 13C

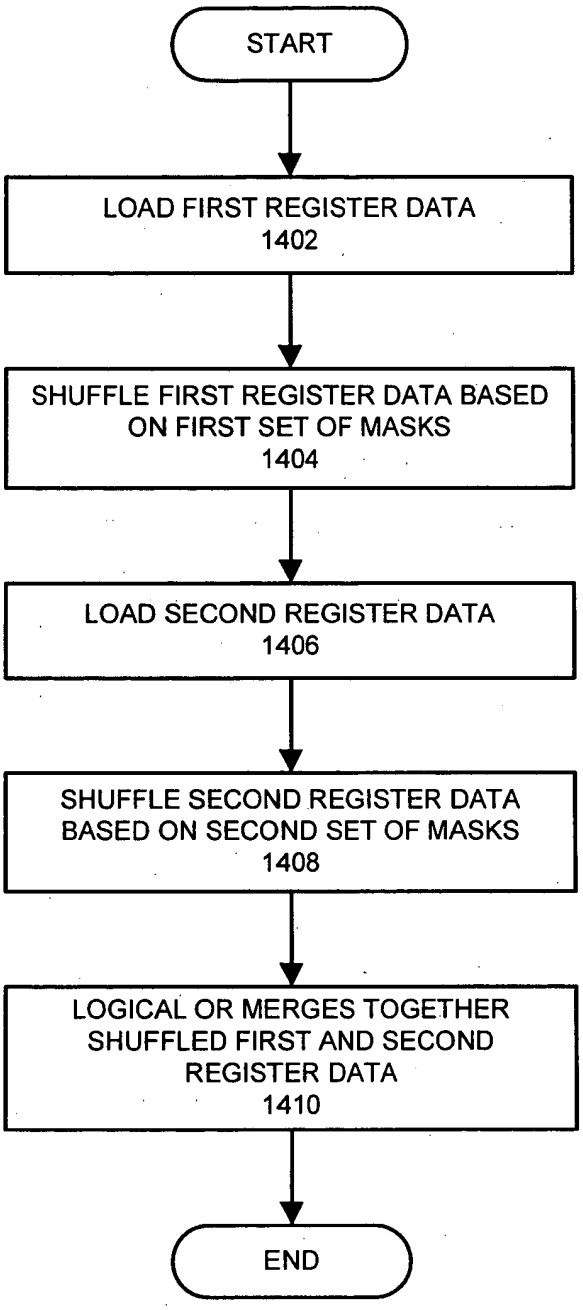

START
LOAD FIRST REGISTER DATA
1402
SHUFFLE FIRST REGISTER DATA BASED ON FIRST SET OF MASKS
1404
LOAD SECOND REGISTER DATA
1406
SHUFFLE SECOND REGISTER DATA BASED ON SECOND SET OF MASKS
1408
LOGICAL OR MERGES TOGETHER SHUFFLED FIRST AND SECOND REGISTER DATA
1410
END

FIG. 14

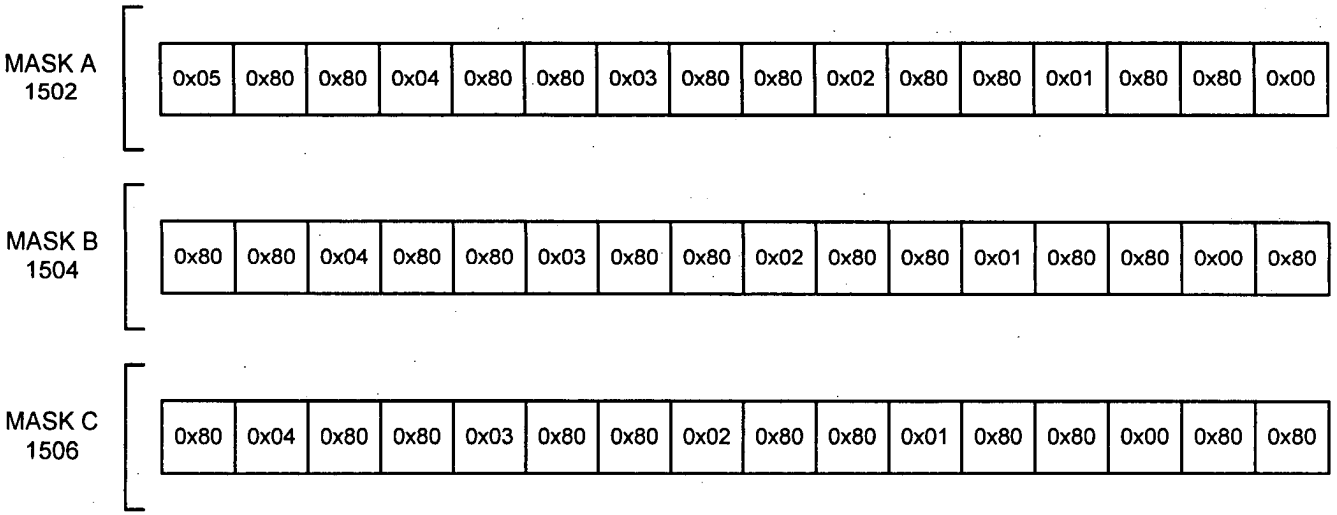


FIG. 15A

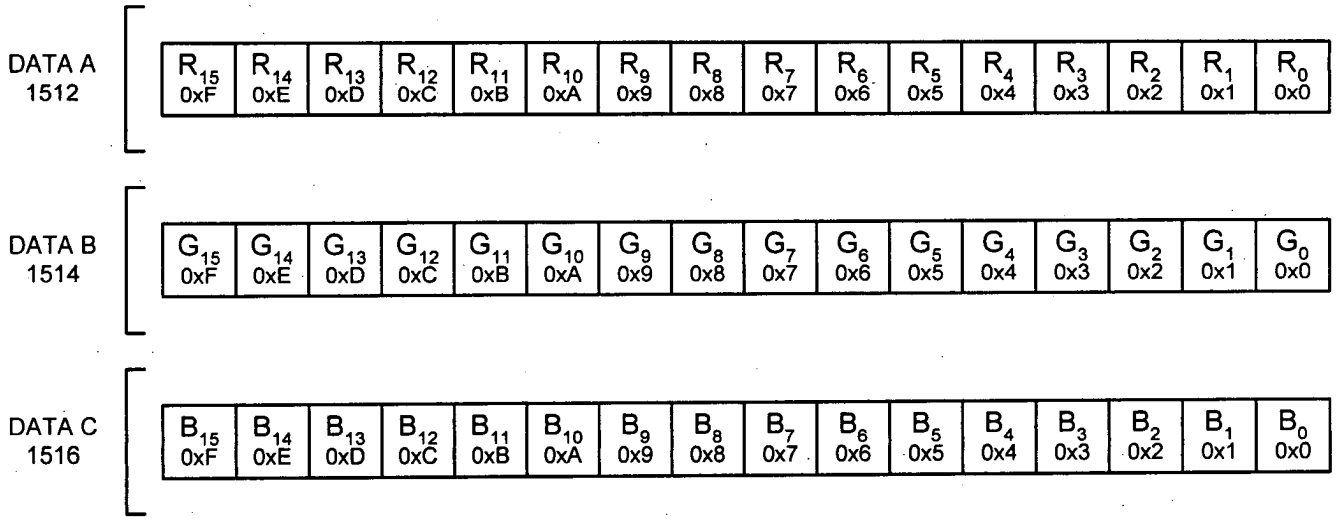


FIG. 15B

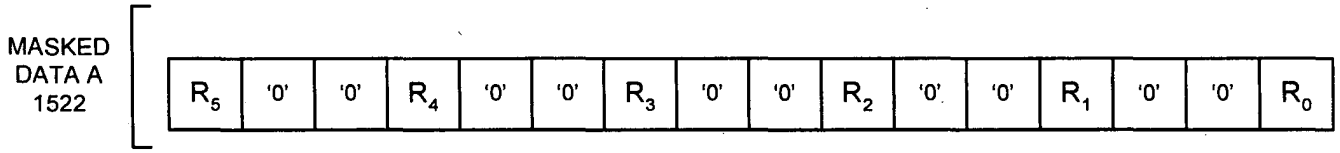


FIG. 15C

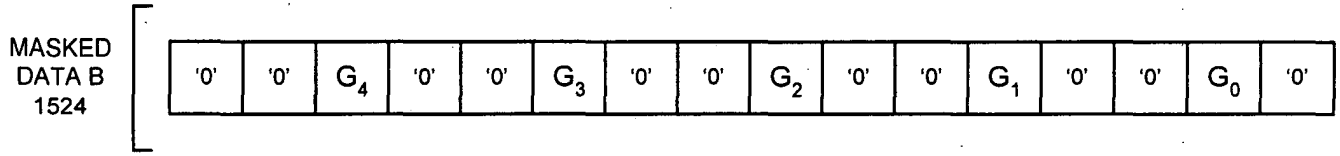


FIG. 15D

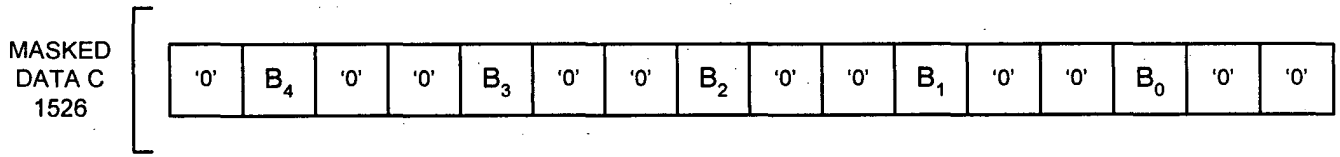


FIG. 15E

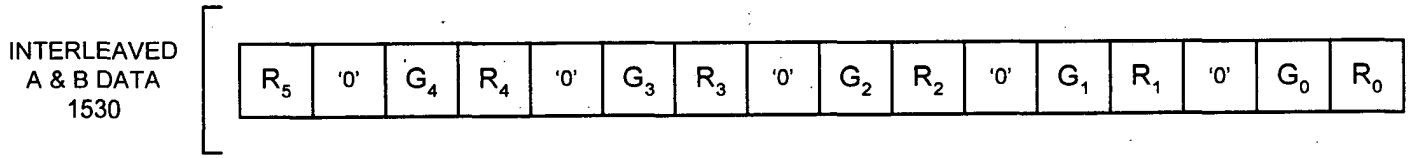


FIG. 15F

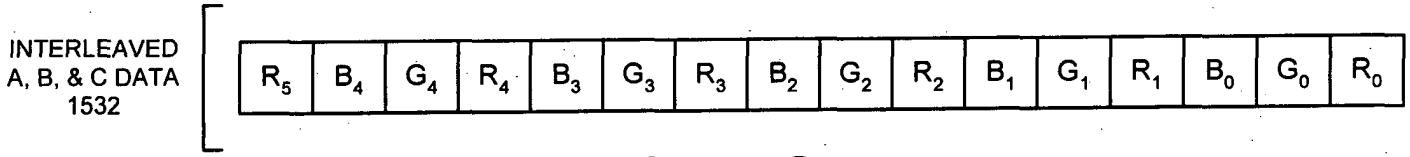


FIG. 15G

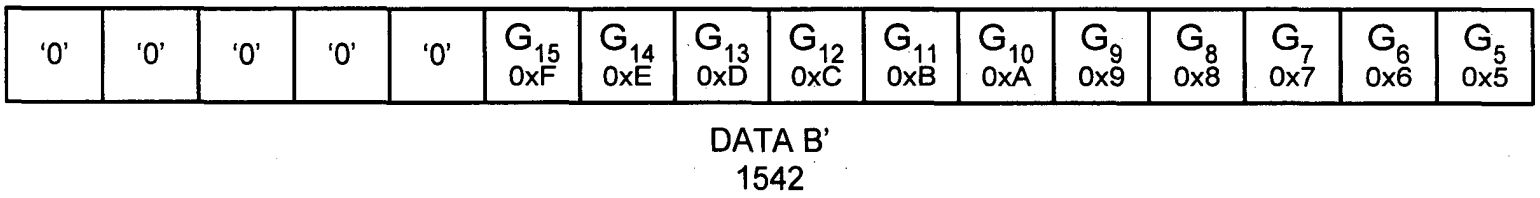


FIG. 15H

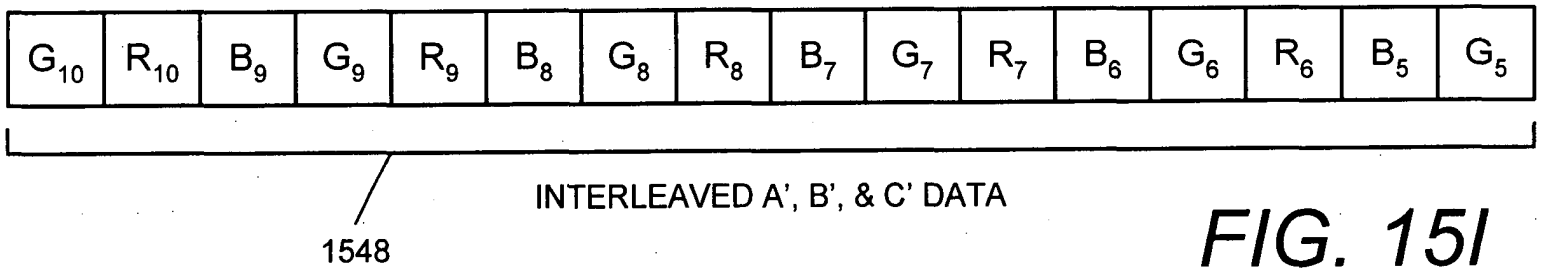


FIG. 15I

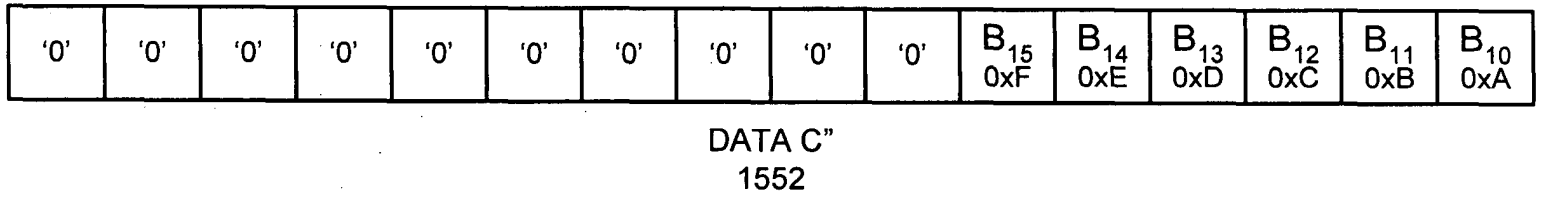


FIG. 15J

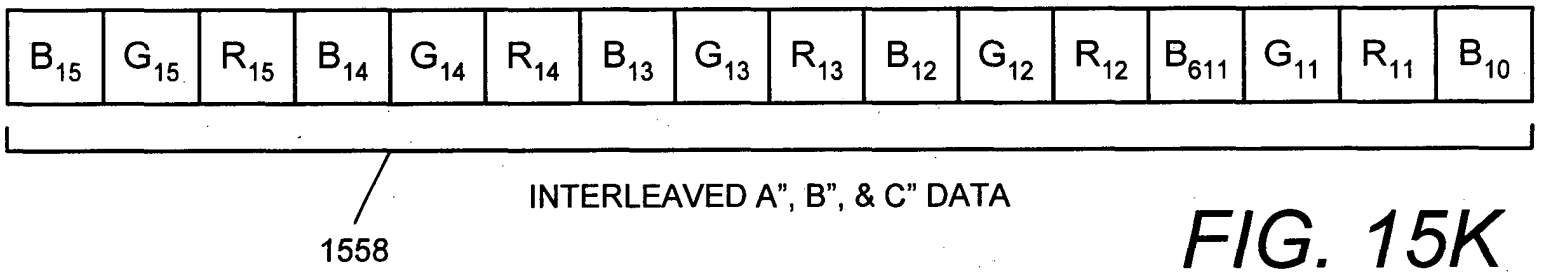


FIG. 15K

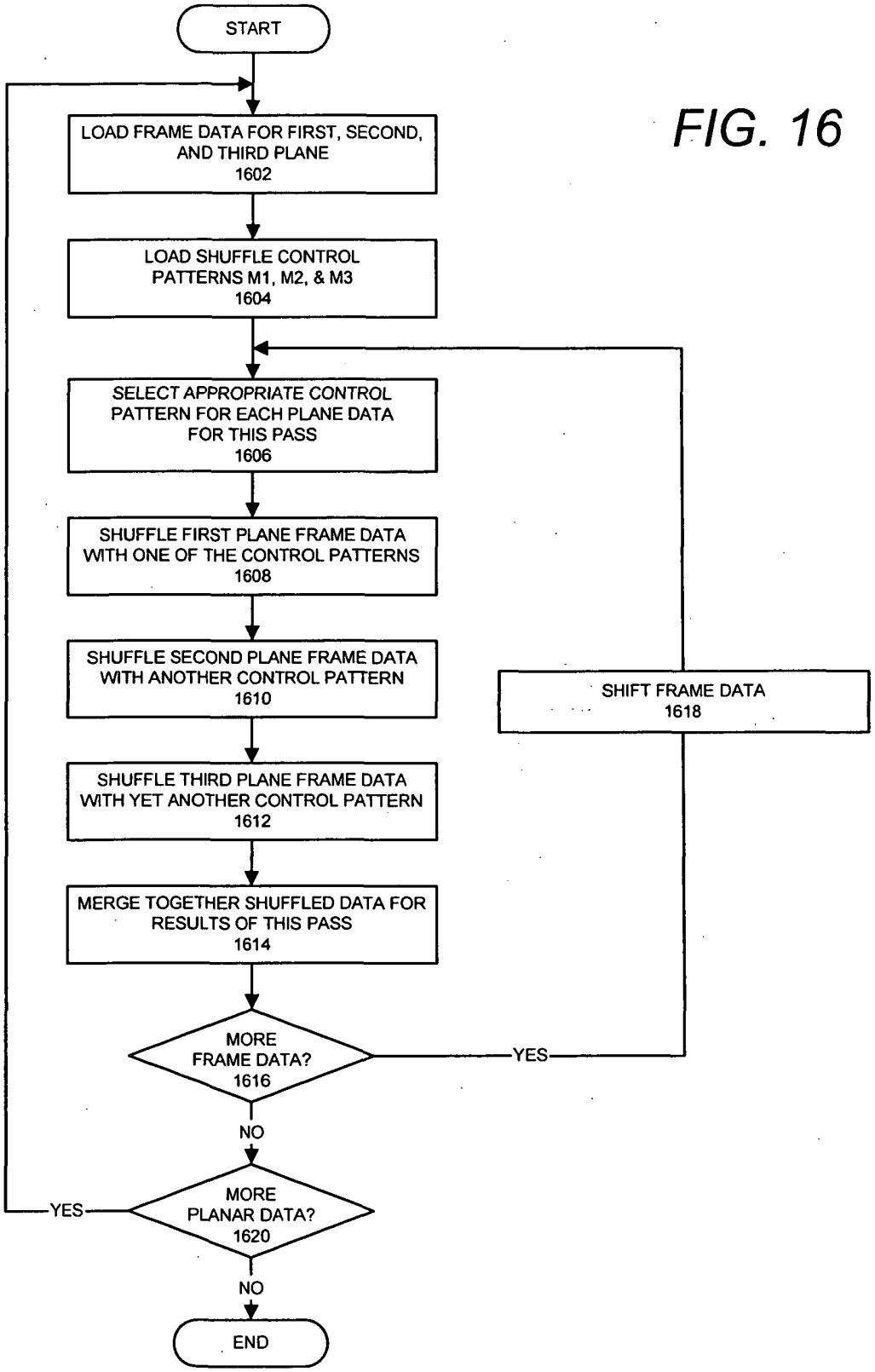

START
LOAD FRAME DATA FOR FIRST, SECOND, AND THIRD PLANE
1602
LOAD SHUFFLE CONTROL PATTERNS M1, M2, & M3
1604
SELECT APPROPRIATE CONTROL PATTERN FOR EACH PLANE DATA FOR THIS PASS
1606
SHUFFLE FIRST PLANE FRAME DATA WITH ONE OF THE CONTROL PATTERNS
1608
SHUFFLE SECOND PLANE FRAME DATA WITH ANOTHER CONTROL PATTERN
1610
SHUFFLE THIRD PLANE FRAME DATA WITH YET ANOTHER CONTROL PATTERN
1612
MERGE TOGETHER SHUFFLED DATA FOR RESULTS OF THIS PASS
1614
MORE FRAME DATA?
1616
YES
SHIFT FRAME DATA
1618
NO
MORE PLANAR DATA?
1620
YES
NO
END

FIG. 16